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See How the Patented Centrifugal Force Process Makes the Linings in Federal Bearings Absolutely Uniform

Note the Wonderfully Close Grain, the Fine, Even Crystallization and the Uniform Texture

THESE microphotographs (enlarged 100 diameters) show the physical difference between bearings lined by usual methods —and Federal Bearings, lined by our Centrifugal Force Process.

Engineers say that this Centrifugal Force Process—by which bearings are lined under the pressure of centrifugal force at 3250 R.P.M.—is the greatest single forward step in the history of the Bearing Industry.

The Centrifugal Force Process automatically controls the rapidity of cooling. Each bearing is lined in exactly so many seconds and the cooling is always in exactly the same ratio to the lining process. Thus every Federal Bearing Lining is uniform in texture, remarkably close grained and extremely tough. It will not flake off. Because of the purely mechanical nature of the process there is never any variation—and every Federal Bearing is exactly like all other Federal Bearings.

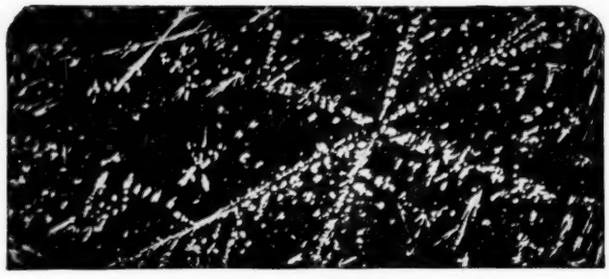
Another special advantage of Federal Bearings is the fact that the linings adhere to the backs throughout the whole life of the bearing—first, because the bonding alloy is at the correct temperature during the lining process, and second, because the Babbitt Metal is distributed by centrifugal force under great pressure with absolute uniformity over the whole surface of the back.

You need Federal Bearings in your motor because they will greatly increase the life of the most wear-subjected parts, and thus add to the reputation of your motor for stamina. Write for complete details about the Centrifugal Force Process. Learn how it insures absolute uniformity in every Federal Bearing.

This Shows Why Federal Bearings Wear Longer

MICROPHOTOGRAPH of the Babbitt Lining of a Federal Bearing, enlarged 100 diameters. Compare this picture with the one shown below. See how wonderfully close the grain is in this Federal Bearing. Note the dense crystallization, the fine structure and the absolute uniformity of grain. Naturally this makes Federal Bearings tougher and better wearing. They last longer and have no weak spots.

This finer crystallization in the Babbitt Lining of Federal Bearings is due to the rapid rate of cooling—which prevents the large and uneven crystallization so noticeable in the bearing pictured below.



Note the Large Crystallization In This Bearing

MICROPHOTOGRAPH of a bearing used by a well-known automobile, enlarged 100 diameters. To the naked eye it looks like a good bearing. Undoubtedly the car manufacturer thinks it is a good bearing. But notice the large and uneven crystallization—which means a lining of varying character and one which wears unevenly. This large crystallization is due to the slow rate of cooling and to the unavoidable variation of pressure during the lining process. This picture graphically shows the physical and structural defects, which while not visible to the naked eye, do, nevertheless flake off and greatly shorten the life of such a bearing.

FEDERAL BEARING & BUSHING CORPORATION

BABBITT-LINED BRONZE-BACK BEARINGS_BRONZE BUSHINGS_BRONZE CASTINGS

DETROIT — MICHIGAN

AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

VOL. XLVI. NEW YORK—THURSDAY, MARCH 16, 1922 No. 11

Gasoline Bus or Trolley Bus —Which?

The author, who has had a broad experience both in this country and abroad, discusses the relative usefulness of each type of vehicle and carefully weighs the value of each in municipal transportation.

By Walter Jackson*

FEW facts will support the assertion that there is no place for either the track or trackless trolley in city transportation services. There are, however, just as few facts to support the assertion that there is no place for the gasoline motor bus in such services. Each has its definite place, and this article is written, not in an attempt to show the disadvantages of the trackless trolley, but rather to show the advantages of the gasoline bus. In a great many cities, both in this country and abroad, this form of transportation has proved its value both to the operator and to the public. It has certain definite advantages which could never be gained with the trackless trolley. However, the old adage of Sir Roger de Coverly, "There is much to be said on both sides," still holds true.

Counsel on this subject has been darkened by the nature of many estimates of cost published by manufacturers' representatives on both sides. They usually assume some general condition, such as intervals between vehicles and number of people to be carried a given distance. Cost of power, upkeep and depreciation are made as favorable to that particular writer's side as possible. The other fellow's estimates are magnified and his hopes belittled. Quite naturally we are led into a triumphant "Q. E. D.," proving that only in a few exceptional cases may the other fellow have a look-in.

In real life, however, we find that this or that vital figure in the commercial estimate is decidedly different in the individual or specific case before us. Aside, also, from the question of cost, we find that other elements enter at times, such as flexibility of route, need for a mobile corps, fixed or intermittent traffic needs, legal technicalities, such as New York's and London's esthetic viewpoint of the public, and so on. For these reasons the writer will try to show in the following discussion how different conditions lead to different conclusions.

Since the cost of power is one of the three or four largest items in running either kind of bus, it is well to understand where this element is dominant in making a choice. The Tees-Side (England) case furnishes a good example, inasmuch as the writer studied this property in detail on the ground in the summer of 1921.

The territory served consists of a number of small steel mill towns, totaling 45,000 people. These towns are connected by but one main road which would be the only one available for any form of transportation. It followed, therefore, that no mistake could be made in using a fixed structure. The project of giving service to this district, covering a route length of some 5

*Consulting engineer.

miles, came up during 1918 when gasoline was not only extremely high priced (about 60 cents per imperial gallon), but also restricted in supply. On the other hand, one of the steel mills was prepared to supply electricity for 10 years at the very low price of 1.5 cents per kilowatt-hour. The difference in favor of electric power was about 8 cents per mile. During the earlier period of operation, when gasoline went still higher, the difference in favor of electricity, naturally, was increased.

It will be clear that the Tees-Side Railless Traction Board was fully justified in adopting the trackless trolley. The difference between gasoline and electricity was so great that it might well be expected to wipe out any possible advantages due to the greater earning power of a fully flexible bus. Besides, it has been pointed out that only one highway was available in any event. On the other hand, had gasoline prices been closer to those in this country, a different decision might have been in order, because a difference of but 3 or 4 cents might have been offset by the possibility of running the buses a few miles farther to the seashore. British summer days are long, and Britishers are so fond of the open air that in non-working hours the gasoline buses would be earning top-notch fares, whereas most of the trackless trolley buses are then idle. And this is a sixteen-bus installation, too.

Installation in Yorkshire

Within the same province, Yorkshire, is another trackless trolley installation. This is in the charming old city of York. There are but four buses run on a route 1¼ miles long through narrow streets that would not allow track operation in any event. In this instance we have a good example of how changes in the cost of power can affect the question of what trackless vehicle to use. At York the choice had to be made during 1920. The difference between gasoline and electricity costs was not so great as at Tees-Side, since power at York would be billed by the lighting department of the municipality at 2.5 cents instead of 1.5 cents per kw.-hour. But one year has produced a different picture, owing to a considerable fall in price of gasoline. We learn that the City Council is prepared to reopen the question before it decides upon the character of operation for running to the suburb of Clifton.

Generally speaking, the sane advocate of trackless trolleys for England bases his chief argument on the saving in power. Thus, an article in the Nov. 17, 1921, issue of the *Railway & Tramway World* notes a case where the difference is 8 cents (12 cents—4 cents) in favor of electricity. In other words, the trackless trolley is preferred because electric power is but one-third the cost of gasoline power. Does this ratio apply in the United States? Let us see.

Operating Costs

In examining the estimates of electrical manufacturers' engineers here, we find that a gasoline bus weighing 10,000 lb. is credited with but 4 to 4.5 m.p.g., whereas the gasoline bus makers aver that 7 m.p.g. is nearer the possibilities. If we compromise on 5.5 m.p.g. with gasoline at 27 cents per gallon, the cost per bus-mile would be approximately 5 cents.

On the other hand, the electrical man figures only 2.5 cents per kw.-hour, which at an overall energy consumption of but 1 kw.-hour per bus-mile would make the cost of electricity one-half instead of one-third the cost of gasoline. Actually, the condition would not be so favorable. Only the larger power plants could deliver kilowatt hours at the rate named. On one property with which the writer was concerned the cost of power was really more than 3.5 cents per kw.-hour. Nor was it likely that the energy consumption per 10,000-lb. trolley bus would be as low as 1 kw.-hour per mile after lighting, heating and transmission losses were taken into account. Based upon foreign studies, the writer concluded that the trolley bus would take at least 1.25 kw.-hours per mile. This consumption at 3.5 cents per kw.-hour meant a power cost of 4.4 cents, or but 0.6 cent less than gasoline.

From the foregoing it will be plain that the cost of power as we find it in any given situation must control, and not some generalized cost. The Tees-Side property, with its 3:1 ratio, was justified in adopting the trackless trolley, but a property with only a 1½:1 ratio in favor of electricity ought to do considerable thinking.

While platform labor is a heavy item in operating expense, it is common to both kinds of buses. Hence we need not discuss it here. In some estimates a factitious advantage is shown for one or the other by assuming a difference in schedule speed per hour, and so crediting the faster bus with a lower wage charge. In practice this is not likely to obtain in city extension, crosstown or suburban service because either type will meet the conditions. We can, therefore, proceed to the next disputable item—namely, the likely upkeep cost of each kind of trackless vehicle.

If experience with trackless buses actually in use in Great Britain for some years were to be our sole guide we would find a surprisingly small difference between the repair cost of trackless and gasoline buses. Bradford and Leeds show costs in excess of 10 and 12 cents per mile, with the more modern Tees-Side much the same. During like periods the larger British bus undertakings, such as Sheffield, showed 9 cents and upward. In the latter cases we are dealing with vehicles approaching the end of their careers. The repair costs of the Aberdeen and Edinburgh buses are approximately one-half as much because the buses are newer and more efficient. Much the same figure (4.6 cents) is given in the case of the York trolley bus, but this does not include body reinforcement charges which were assessed against the bus builder.

Maintenance Comparison

If this is the story of the past and present of gas and electric buses in England, what of the future? In this respect the writer was assured by J. B. Parker, the general manager of the Tees-Side system that his new 36-seat bus was not expected to exceed 5 to 6 cents per mile maintenance cost. Now, in the *Tramway & Railway World* article, previously mentioned, the writer thereof, although advocating the trackless trolley, states that the "additional maintenance of petrol engine over electric motor" is ½d. or 1 cent per mile. Compare this with the American assertions that the trackless bus will tend to cost but 4 cents to 5 cents per bus-mile against 8.5 cents to 10.6 cents for the gasoline bus. The British writer based his figures on a decade of experience with both kinds of vehicles, whereas the American engineers have been obliged to base their figures on trolley car experience and the operation of motor buses under jitney and other small-scale conditions. Let us hold fast to the fact that the Britisher's outstanding reason for using trackless is not because of its lower maintenance, but because of its lower power cost in so many parts of his country.

On a trackless trolley system, of course, it is also necessary to maintain the overhead line at, say, ½ cent to 1 cent per mile run. If the trackless system were self-contained it would also have a substation to look after. These are additional upkeep costs that tend to

cut down the difference in upkeep costs between the vehicles themselves.

The cost of a trackless trolley bus of, say, 25-seat capacity is now some $1,000 greater ($8,000 against $7,000) than a gas bus of like capacity. On top of this the trackless bus also has the special investment for overhead line (four wires) and feeder wire from substations which would result in almost doubling the investment charges in those thin traffic cases where the number of buses will be fairly equal to the number of miles of route. Even if the investment required was not double, the charges would tend to be higher because money for the trackless trolley equipment could hardly be raised at the favorable rates open to any reliable purchaser of gasoline buses. The obvious reason is that so much of the trackless trolley investment is special, whereas the gasoline buses could be removed at once if their user did not make good.

As an offset to this, the depreciation or amortization charges on the trackless trolley bus should be lower—possibly by 25 per cent or better. But this lies in the realm of conjecture and hope because control, drive and current collection are still in the "x" stage of the equation. The first few months of American experimentation have already brought half a dozen types into the picture.

As shop costs, roadway maintenance, wages, traffic management, etc., would be the same cost in either form of operation, it is needless to detail them here.

An ironical characteristic of communities in the past has been an insistent demand for electric railway service provided the new tracks were laid and the new poles and wires erected anywhere except on the streets occupied by the petitioners. In the end, of course, the line had to be built somewhere amid much gnashing of teeth at the tearing up of streets and the destruction or defacement of trees, etc. What would a residential district be likely to prefer to-day if it wanted mass transport? Would it accept tamely the idea of the old-style overhead with four wires in the air instead of two, or would it naturally desire a neat vehicle using precisely the same motive power as the hundreds of private automobiles and trucks running regularly over the highway? There is not much doubt as to the answer the public would give.

Good will is so essential to a mass transport organization that it can hardly afford to incur avoidable antagonism. Where the factors of cost favored the trackless trolley it might be good policy to let the public express its preference with the understanding that whatever system was adopted must receive compensatory fares, whether on a flat or distance basis. In the case of extension through factory districts, on the other hand, this esthetic point would not arise and the trackless would have much in its favor.

As a practical operating matter it is well to point out here that it is often an open question whether the extension should be a shuttle service from the old trolley terminus or whether it should be a combination of non-stop running between city center and trolley terminus, plus local service thereafter. The adoption of gasoline buses permits trial of both plans. The adoption of trackless trolley buses permits application only of the shuttle plan, for it is not practicable yet to run trackless buses and electric cars under the same overhead structure for any considerable distance.

We now come to the preponderant factor from the money-making standpoint, that of relative earning power. Here the foot-loose gas bus is without a competitor. It is simply a question of determining whether its potentially greater earning power is exploitable enough to the point where it wipes out any greater overall expense. A few examples will suffice to illustrate this point.

One day as the writer sat in the office of the Sheffield Tramways he observed a poster on the wall advertising motor-bus runs to the Rivelin Valley to be given Sundays and holidays only. On inquiry he learned that the buses used for this service are part of the fleet which on business days is engaged in the company's trolley line extension services. For this holiday service the municipality receives a substantially higher rate of fare than for regular running. A cross-country example is the Birmingham & Midland Motor Omnibus Company, which runs scores and scores of overland routes every day in the week. But it is always possible to use a portion of the fleet to carry parties of friends from anything like a football game to a festival play at Stratford-on-Avon, the routing and stop-overs being arranged according to the convenience of the customer.

So, too, in pre-war days the buses of Berlin were largely diverted on holidays from city to woodland travel.

These are merely examples of the shifting of the bus from business to pleasure travel. The opportunities for moving them from one line to another in metropolitan service is simply infinite, as will be discovered by anyone who studies the operations of a concern like the 3000-bus London General Omnibus Company. To run, also, two, three or four times as many buses in one direction as in the other is no novelty at all.

WHILE Mr. Jackson has not attempted to set forth all the factors that enter into the problem of the trackless trolley or bus, enough has been presented to make clear the point that there is no general answer to the question, that the assertions of the enthusiasts on both sides should be sifted item by item and that the less tangible but weighty factors of public good will, flexibility to meet emergencies and potential earning power must be studied as carefully as the comparative investment and running costs themselves.

The ability to get around obstacles, as in the case of parades, fires and other temporary obstructions, obviously is possessed only by the bus that is not tied to rails or wires. The value of flexibility in a given case where the best route was being felt out was brought home recently to the writer in connection with the abandonment of two low-traffic trolley routes. Instead of slavishly following the old routes with buses, the company has been trying out certain detours that will bring its vehicles into contact with more riders. In fact, during some hours it will make changes to attract people who would otherwise want to use their cars for the comparatively short run to the golf links. With the best will in the world, no one could have set down a trackless trolley route that would have been right and stayed right from the standpoint of maximum revenue from, and therefore maximum service to, the public.

The foregoing incident came up in a town of less than 25,000 population, where one would not expect many opportunities for diversity of use. Yet hardly had the buses been in use two or three weeks than a local fraternal club was greatly pleased to learn that it could engage one for the later hours when only part of the equipment was needed in the regular runs. The value of the bus fleet in keeping off competition is no mean

factor, either. The trolley run to a nearby town is no longer the shortest or quickest way. It would be possible for a jitney operator to do much harm by running a competitive bus. He is not doing so, because the company can play the game of "freeze-out" a lot better than he.

Buses for Seasonal Work

No one will question that the gasoline bus is the only thing to use where the traffic to be carried is of seasonal or intermittent character, as to fair grounds, parks, etc. There are many situations, however, on the border line. Service to a college is a case in point. Analysis will show how many days in the year and how many hours in the day the college is in session and, therefore, in need of transportation. Then is the time to see whether the permanent or the removable service is better, all things considered.

Then, too, is the possibility of using the gasoline motor bus as a rush-hour relief, for the reason that it can give non-stop runs over a large number of streets, whereas it would be absurd to think of erecting half a dozen trackless trolleys for that class of running. Such auxiliary service might not pay in itself, but would help to speed up the main traffic arteries and keep off the cost of street widening or of building elevated trackways or subways.

Finally, as regards overland running, there seems little chance for the trackless trolley at its present stage, owing to the fact that it could not meet the high speeds possible with small-capacity, high-powered buses. This field will probably build up to thousands of installations, small in themselves but imposing in the aggregate.

The foregoing discussion has not attempted to set forth all the factors that enter into the problem of trackless trolley or bus. It is hoped, however, that enough has been presented to make clear the point that there is no general answer to the question, that the assertions of the enthusiasts on both sides should be sifted item by item and that the less tangible but weighty factors of public good will, flexibility to meet emergencies and potential earning power must be studied as carefully as the comparative investment and running costs themselves. The apparent fact that there seems to be more opportunities for gas than electricity should not interfere with the acceptance of trackless or even track trolley where the cost of electric power and the permanence of good travel are unusually good.

A New Refractory Insulating Material

ISOLANTITE is a new ceramic product developed in France during the war for which superior qualities as a spark plug insulator are claimed. It is made by a new process which is said to improve upon the good qualities of porcelain and to obviate its defects. No glazing is required to prevent the penetration of water and oil, and the material can be milled, planed, threaded and drilled, the same as metal, and with the same degree of accuracy.

Tests of the physical strength of Isolantite were made at the French Government Laboratory in Paris. These tests were made on two series of cylinders about 0.8 in. in diameter and of the same length. One of the series was fired in an oxidizing atmosphere and in consequence was yellow in color, while the second series was fired in a reducing atmosphere and was white in color. The resistance to crushing was determined at different temperatures up to 1500 deg. Cent. by special methods available at the laboratory. Of each grade of material three samples were tested, and the results averaged, and converted into English measures, are given in the following table:

Temperature, Deg. Fahr.	Breaking Strength, Lb. per Sq. In. Yellow Samples	White Samples
59	37,683	32,521
2012	9,456	7,437
2192	4,233	2,915
2372	2,702	2,076
2552	384	213
2732	0	0

The crushing at ordinary temperatures was effected in the hydraulic press. Between the ordinary temperature and 2012 deg. Fahr. it was not possible to break the cylinders, the pressure required being beyond the capacity of the press used. At 2732 deg. Fahr. the material is completely melted.

Tests for dielectric strength were made at the Central Electrical Laboratory of Paris. In this case cylinders about 3 in. long and 1¼ in. in diameter were used. There was an axial hole about ⅜ in. in diameter at one end of the cylinder, of varying depth, so as to leave a bottom of different thicknesses, according to the type of the sample. Some of the samples were glazed on the cylindrical surface and head.

Tests were made to determine the dielectric strength for different thicknesses of insulating material, both when dry and after immersion for 24 hours in water at atmospheric temperature. In making the tests, each cylinder, submerged entirely in oil, rested with its base on a metal plate which was connected with one terminal of a transformer, the other terminal of which was put in mercury at the bottom of the hole in the cylinder. Electric pressure was applied to an initial voltage of 20,000 and was then gradually raised in steps of 1000 volts.

With cylinders of 4 mm. thickness at the bottom, unglazed cylinders not submerged in water punctured at 60,000 volts, and two glazed cylinders punctured at 50,000 and 60,000 volts respectively. Cylinders having been submerged in water for 24 hours punctured at exactly the same pressures as the dry ones. On the strength of the above figures it is claimed by the manufacturers that the dielectric strength of Isolantite is 75 per cent greater than that of wet process electrical porcelain.

Income Tax Procedure

INCOME Tax procedure is a mystery to almost all persons who are not connected in some way with the legal profession, and for that reason it is advantageous to know of a reliable source from which accurate information may be obtained. Such a source is the 1922 edition of "Income Tax Procedure" by Robert H. Montgomery, C.P.A., published by the Ronald Press Co.

While dealing with the new Income Tax Law in detail this book includes Matter on the Federal Capital Stock Tax, Federal Estate Tax and a supplement to excess profits tax procedure of 1921. Two valuable features of this book which should be mentioned, are: The policy of quoting exactly from law and regulations all material of importance in the preparation of returns, and, the including in footnotes facts concerning former law and procedure, this latter serving to help in the solution of problems arising over old returns.

New Durant Product Makes Good Impression

Star car compares favorably in design with cars selling in next higher price class. Parallels Ford in prices of all body models. Has 102 in. wheelbase, pump circulation, long, semi-elliptic springs, conventional gearset, storage battery and several other features usually found in higher priced cars.

By Herbert Chase

WASHINGTON, March 9, 1922.

DURANT and his engineers, collaborating with a number of parts makers, appear to have done the thing which many have thought possible but few have seriously attempted, the production of a car of conventional type and free from certain types of construction peculiar to the Ford product, but intended to sell at a price the same as that of the Ford in all body models. This car, to be known as the Star, was shown here publicly for the first time, to-day, and proved to be the center of intense interest on the part of the public as well as many men prominent in the automotive industry.

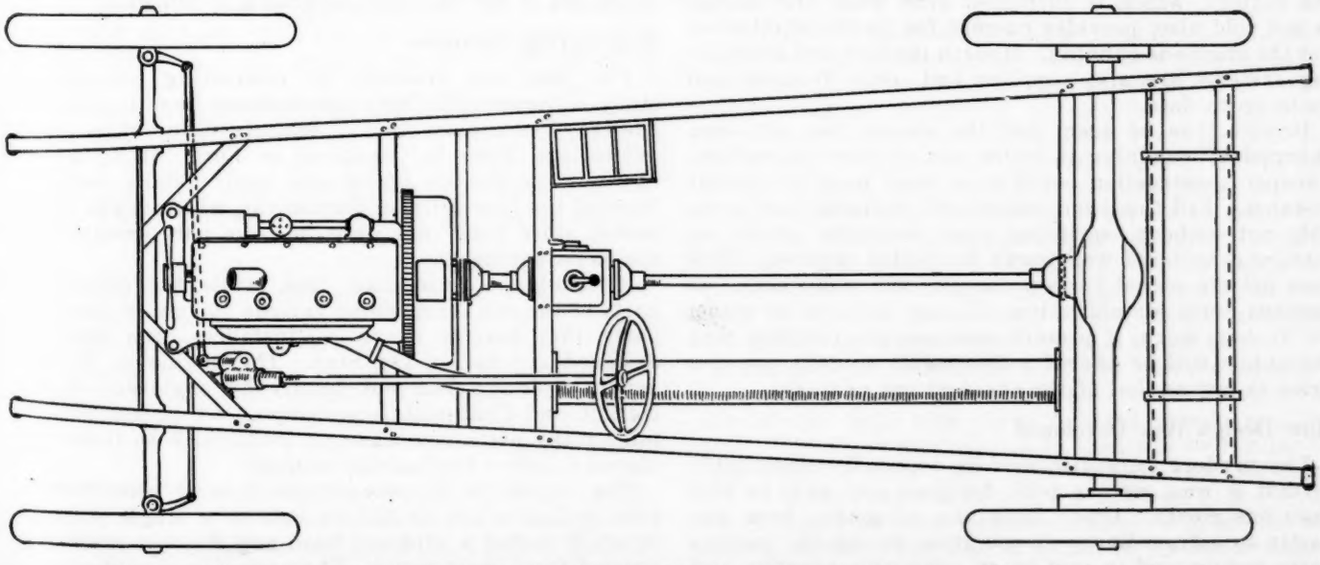
Expected to Heighten Competition

The new product compares favorably in design with that of concerns which have heretofore come close to Ford in the price of their cars but sells, when equipped with demountable rims and starters, for about $100 less than the least expensive of well-established makes, other than Ford, now on the market. Just what this will mean, especially to Ford and his nearest competitors in the price scale, remains to be seen, but if the move proves to be all that it appears to be on the surface and is carried through in respect to sales and service in a manner similar to that which has proved so successful with Ford, there seems to be little reason to doubt that it will heighten competition and prove to be a large factor in the automotive trade of the country.

The Star Company for whom Durant will make the car on contract has not yet been incorporated. Those in a position to know are emphatic in their statement that the various parts makers will not be stockholders, a statement which is borne out by representatives of parts manufacturers who came here to see the new car and learn more regarding plans for its manufacture, and sale. Sales plans are not yet worked out, but it was learned on good authority that the intention is to follow closely Ford's marketing policy. There will not, in any case, be exclusive territorial allotments, and there will, as with Ford, be as many agencies in each town as the trade warrants.

Most Units New in Design

The car is not, as some assumed, wholly an assembly of existing parts. Most of the units are quite new in design, but a few are now used in existing cars. The design is not the product of any one engineering organization. It has been worked out by Durant engineers in co-operation with the engineers of the various parts companies interested in supplying the various units. On this account the components of each unit are already standardized and in use to a certain extent, but other parts have been specially designed to meet the particular con-

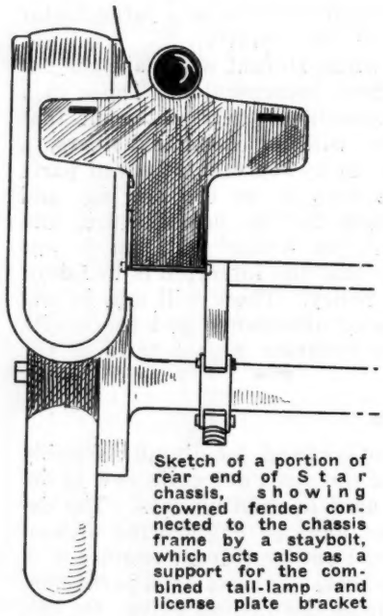


Diagrammatic sketch showing approximate layout of the chassis of the new Star car. Side rails and all cross members save that under rear end of engine are straight

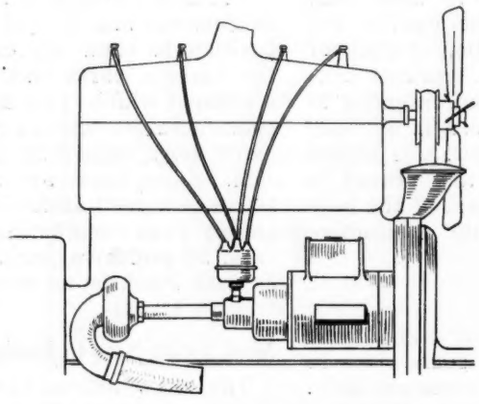
dition so that the units as assembled are not in most cases duplicates of units used in other cars, though they are mostly of conventional design and are so laid out as to facilitate ready production with existing tool equipment wherever possible.

In general the design is quite similar to that of the Durant Four, being characterized by the use of a tubular frame member, which serves as a muffler, but is primarily intended to prevent twisting of the frame with consequent body weaving, and the employment of a separately mounted gearset located amidship, instead of the unit power plant used by Ford and nearly all other American car manufacturers. This construction adds certain parts, but has material advantage in the way of added accessibility, especially in respect to the clutch.

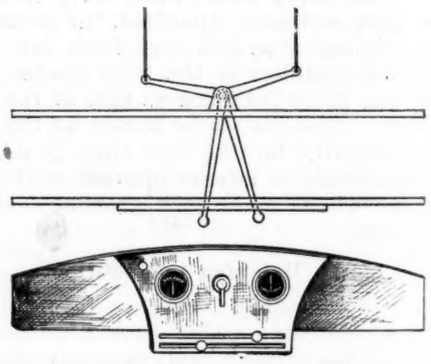
The longer wheelbase and wider frame enable the use of a body which is not unduly cramped and is reasonably comfortable, while the body lines are modern and as pleasing as those of most cars in the low-price class.



Sketch of a portion of rear end of Star chassis, showing crowned fender connected to the chassis frame by a staybolt, which acts also as a support for the combined tail-lamp and license plate bracket



Sketch showing general arrangement of the chain-driven Auto Lite generator and ignition unit, and the water pump, which is at rear end of cylinder block



Sketch showing approximate layout of instrument board. The spark and throttle levers are bell-cranks which project through the dash and are connected by rods to timer and carbureter

The long semi-elliptic springs should also make it easier riding. The lamp equipment and arrangement appears to be as good as that on many higher priced cars, and the battery, which is furnished even when the starter is not sold also, provides current for lights whether or not the engine is running. Modern ignition and lubricating systems are also supplied and other features are quite up to date.

It will thus be seen that the design has not been skimped by confining it to the use of bare necessities. Cheaper construction could have been used in several instances, had this been considered desirable, but probably not without sacrificing some desirable quality or feature considered well worth the added expense. This does not mean that certain changes and refinements, or perhaps some simplification will not in time be made, but it does mean, if present promises are fulfilled, that the public will be offered a thoroughly modern car at a price as low as that of the cheapest car of to-day.

How Design Was Developed

The product here discussed is especially remarkable in that it was, we are told, designed and built in less than one month's time. This has, of course, been due partly to extraordinary co-operation among the various parts makers and in part to an unusual conception and execution of a plan worked out by Durant engineers. We understand that each parts maker was given a certain limit in respect to price and the space available and told to offer the best he could within these limits. The result is highly commendable and one which could probably not be duplicated in any other country and perhaps not in any other industry, save the close-knit and progressive automotive industry.

Durant plans to begin production of the new car about June 1 at the rate of about 50 cars per day, this rate to be increased to 500 per day as rapidly as possible. It is expected to reach 1000 or more per day in 1923. Parts makers are tentatively working upon plans which call for units for 500 cars per day by Sept. 1, 1922. First deliveries are expected June 15.

It has not yet been announced at which, if at any of the existing Durant plants the new car will be assembled, but it is probable that a portion of the Long Island City plant will be used at least temporarily for cars to be delivered in that vicinity. The prices quoted are, however, "plus freight from Detroit" as in the case of Ford sales.

The new car, it is understood, will not in any way interfere with the manufacture of other Durant products, which are to be continued according to schedule.

Engineering Features

The Star car presents an interesting engineering study, although it follows conventional lines in most respects. The construction is entirely different in many particulars from that employed by Ford. In a number of ways the chassis layout and many details resemble those of the four-cylinder Durant car, which might be expected since both cars were in large part designed by the same engineers.

It should be understood that, while the component parts of the car are made by various makers of standard parts, they have in nearly all instances been specially designed for use in the Star. The engine is, for example, a design laid out jointly by engineers of the Durant and Continental companies, but necessarily retains many parts similar to, or identical with those employed in other Continental engines.

The engine is of conventional L-head construction, with cylinders and crankcase cast in a single piece to which is bolted a separate head and a lower crankcase pressed from sheet metal. The engine is described as a high speed type and is said to develop a maximum of 35

hp. at 2500 r.p.m. It is of 3⅛ bore by 4¼-in. stroke, giving a piston displacement of 130.4 cu. in. as compared to the Ford with 3¾ by 4-in., with a piston displacement of 176.7 cu. in. The engine is said to weigh about 10 lb. less than that used in the Ford, but, because of its higher speed, to have considerably more power. It differs from the Ford engine in a number of other particulars, the most important of these being the use of a chain instead of gears for driving the camshaft and the combined lighting generator and ignition units, and in the use of a pump instead of thermo-syphon circulation. The pump as now arranged is located near the rear end of the engine and is driven off an extension of the generator shaft. The chain is arranged in a triangular layout and is enclosed by a cover of sheet metal.

Carbureting and Electrical Equipment

Besides the spark plug holes there are, in the head over each cylinder, holes tapped with ⅛-in. pipe thread in which priming cocks can be inserted, but the engine shown was not supplied with the cocks. The inlet and exhaust manifolds are cast with one common wall which serves as a hot spot to heat the incoming charge. The carbureter is of Tillotson make and is fed from a Stewart-Warner vacuum tank which draws fuel from the main tank located at the rear of the frame. A hot air stove with short pipe connecting with the carbureter inlet is also used.

The Auto-Lite lighting generator and ignition unit are located at the right side of the engine just back of the chain case. The cutout is placed on the side of the generator and the coil on the top of this unit, while the distributor, which comes about opposite the center of the engine, is on a short, vertical shaft. With this location, short high tension wires to the plugs can be used. A combined oil filler and breather pipe is mounted on the chain case, just above the lighting generator.

The car shown had no starting motor, but the flywheel is toothed to mesh with the conventional pinion with Bendix drive when the electric starter is furnished as an extra.

The oiling system employed is a combination pressure and splash type, the oil being fed under pressure through the hollow camshaft from which it flows, still under pressure, to the main bearings. The connecting rod bearings and pistons are arranged for splash lubrication.

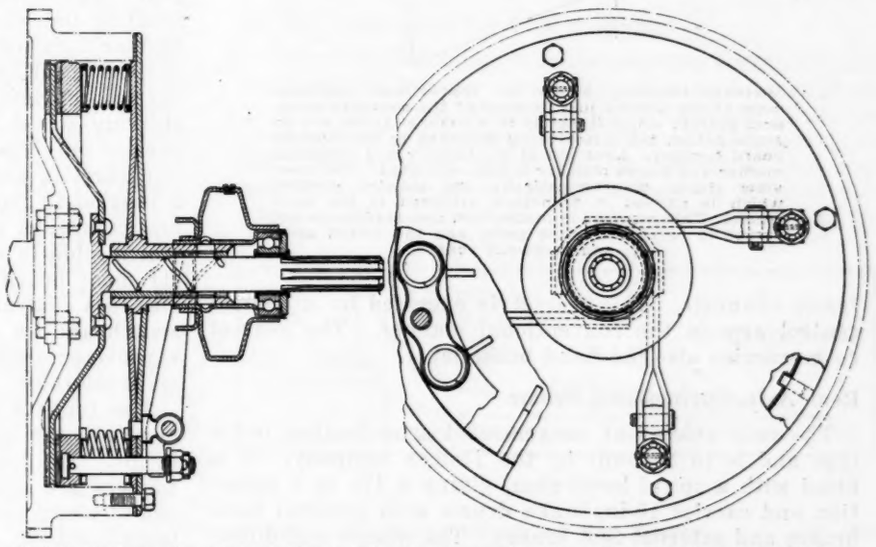
The fan is mounted on a fitting attached to the front end of the cylinder casting and is driven direct by belt from a pulley on the crankshaft. The fan is adjustable vertically to provide for taking up a slack belt.

The combined inlet and exhaust manifolds are located on the left side of the engine. The latter has a four-point suspension, the rear end resting on a channel-section cross member, which is bent downward at the center to pass under the crankcase, and the forward end on the diagonal channels which run from the main side member of the frame to the front cross member.

Clutch and Gearset

The clutch is of the single plate type and is practically identical in general design to that used in the Durant four-cylinder car. The spindle of the light driven member is carried in a sleeve supported from a flange bolted to the rim of the flywheel. This flange, together with the flywheel, completely encloses the clutch, and to the flange are pivoted the disengaging levers which move the pressure ring against the action of the springs which bear directly upon it. Two molded rings of asbestos composition form the clutch facings which float on each side of the driven member. The facings are thus pressed between the face of the flywheel and the thrust ring. The driven plate is thin and is slotted radially at a number of points to prevent heat distortion.

The annular type throwout bearing is enclosed in a pressed metal case filled with oil. This oil serves to lubricate the clutch spindle as well as the throwout bearing.

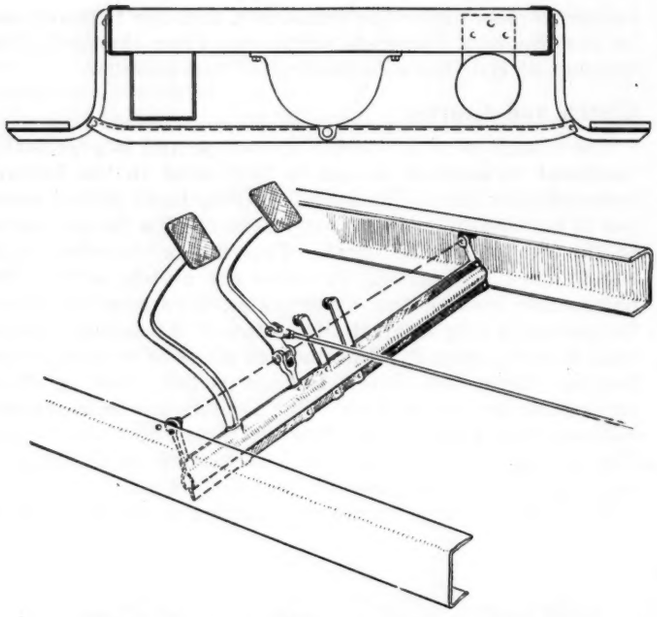


Clutch used on the Durant Four. The clutch employed on the Star is substantially a duplicate except as to a possible variation in number of springs employed

The clutch is operated by a pedal attached to a tubular member which, as shown in one of the accompanying cuts,* runs across the frame under the clutch spindle. This tubular member is carried at each end in trunnions which enable it to swing through a short arc, as the clutch pedal is depressed. A yoke at the center of the tubular member engages the throwout flange of the clutch. The tubular member also serves to carry the pivot for the brake pedal, the axis of this pivot being in line with the axes of the trunnions, which carry the tubular member. For this reason the action of the foot brake is entirely independent of the clutch, although both pedals are supported by the same member.

It has not yet been announced who will manufacture the gearset and the clutch, but the former is to be of conventional type with three forward speeds and reverse. The shaft and gears employed will be similar to those used in other light cars, such as the Chevrolet "490," but the case will be made to conform to the separate mounting on cross members, as shown in the accompanying sketch. The case is bolted to the lower flange of a straight channel cross member, and rests below on an angle iron attached to the running board supports, which are in turn attached to the outside of the main

*We are told that no complete drawings of the Star car have yet been made, and that because of the speed at which the car has been assembled, certain details will be changed, for which reason detailed photographs cannot yet be furnished. On this account and because of the crowd around the car the time it was placed on exhibition the drawing here reproduced had to be worked up from rough sketches made on the spot. The drawings are in part diagrammatic and not intended to show details of construction so much as to give a better picture of the type of construction employed than would otherwise be possible.



Sketches showing, above, an approximate sectional view of the chassis just forward of the separate amidship gearset which is bolted to a channel above and an angle below, the latter being attached to the running board hangers. Location of the battery and combined muffler and frame member is also indicated. The lower view shows diagrammatically the tubular member which is carried in trunnions attached to the main frame. This member is made from two stampings and serves to carry the brake pedal and the clutch pedal and throwout yoke

frame channels. The gearset is operated by a central control arm in the conventional manner. The gearset cover carries also the hand brake lever.

Rear Axle, Springs and Frame

The rear axle is of conventional semi-floating banjo type and is to be built by the Timken company. It is fitted with a spiral bevel gear, giving a 4⅞ to 1 reduction and carries 10-in. brake drums with internal hand brakes and external foot brakes. The wheels and differential are carried on Timken bearings. A rear cover plate permits ready access to the differential, which can be removed through the rear opening.

The rear springs are of semi-elliptic type and are of unusual length for a light inexpensive car. They have six leaves, 1¾ in. wide and measure 48 in. in length. They are underslung from the axle to which they are held by U-shaped spring bolts. The springs are located directly under the frame and are pivotted at their front ends on pins carried between triangular plates riveted to the frame. The rear ends of the springs are carried by long shackles pivoted on the rear horns of the frame. These shackles are stamped from heavy sheet metal formed into an H-section, the central portion acting to hold the side link members parallel. This shackle is similar to that used on Durant cars, except that it is somewhat longer.

The front axle is a Timken product of the usual I-beam construction and has Timken bearings for the wheels. It supports semi-elliptic springs, which measure 1¾ by 34 in. The tie rod is in back of the axle and is just below the drag link, which is connected transversely from the right steering knuckle to the steering arm on the left side of the car.

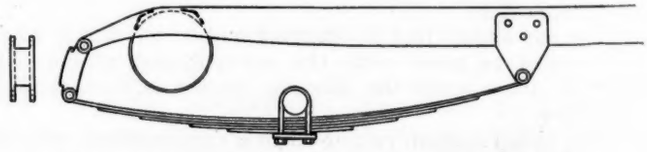
Wheels are of wood and carry 30 x 3½-in. tires all around.

In general construction the frame is very similar to that employed in the other Durant cars. It is characterized by the use of a long tubular member, which is rigidly connected to the cross member in front of the gearset and to the main rear cross-member, which is almost over the axle. This gives the frame unusual rigidity against twisting strains for the tube is of a large diameter and is formed of steel about 3/32 in. thick. It serves also as a muffler. The side members of the frame are made of channel 4 in. deep by 1½-in. flange and are straight, except for the horns formed at the front and rear ends. No kick-up is provided at the rear. All other members of the frame are also straight with the exception of that which supports the rear end of the engine. The fuel tank, which is cylindrical, is carried between the two rearmost cross members. The latter are angle stampings formed approximately to fit the contour of the fuel tank, which is hung from straps which pass over these members.

Narrow diagonal channels are rivetted to the front and side members at the front end of the frame. They not only support the front end of the engine, but that at the left supports also the housing of the steering gear. The latter is of the worm and wheel type with the shaft of the wheel inclined with its lower ends slightly further forward than the upper end. To the lower end of the wheel shaft is attached an arm, which in turn carries the left end of the transverse drag link. The steering wheel is similar to that in general use, but carries only the horn button at its center. The spark and throttle control levers are bell-cranks pivotted on a bracket in front of the dash. The long arms of these cranks project through the dash and terminate in knobs which slide in slots formed at the under edge of the instrument board. The latter is of sheet metal and carries in a central panel an oil gage, ignition and lighting switch and an ammeter, as well as the handle for the carbureter choke. The throttle is inter-connected with an accelerator.

The fenders have a slight crown and are well supported at the front by a tie-rod, which carries the headlamps. The latter are adjustable for tilting. The rear fenders are attached to the frame by short stay bolts, one of which carries a combination license plate and tail lamp bracket.

The rims regularly furnished are not detachable, but five detachable rims and starter are provided at an extra charge, which includes also a carrier for the extra rim, the latter being attached to the rear of the chassis.



Diagrammatic view of rear end of chassis frame showing long underslung semi-elliptic spring arranged for Hotchkiss drive, H-shaped shackle, and cylindrical gasoline tank mounted between two angle members from which it is supported by straps

The wheelbase of the chassis is 102 in. The chassis is arranged to carry the various types of passenger or a light commercial body. It is not expected that an extended chassis, with heavier rear axle for commercial use, will be furnished, as is the practice with Ford.

The equipment of the car includes a U. S. L. battery which, of course, is arranged to provide lights when the engine is not in operation. The battery furnished, when no starting motor is supplied, may be somewhat smaller than that furnished for use in cars equipped with a starter, although this point is not yet definitely decided.

It is claimed that the car is capable of traveling 30 to 35 miles per gal. of fuel. It is said to weigh 1800 lb.

Sperry Compound Diesel Engine

Uses two stage compression of the air and solid injection of the fuel. The transfer valve between the high and low pressure cylinders and the air inlet valve to the high pressure cylinder are mounted concentrically to insure cooling of the former. An increase in fuel economy is claimed.

SOME information regarding the development work on Diesel engines done by Elmer A. Sperry has been given in former issues of AUTOMOTIVE INDUSTRIES, as Mr. Sperry has been pursuing this line of work for the past twelve years and has on several occasions spoken of it in discussions before the S. A. E. The engine has now reached a production stage, and further particulars have been furnished in recent papers before the American Society of Mechanical Engineers and the S.A.E. Motor Boat meeting, on which papers the following article is based.

Diesel himself worked out a compound type of engine working on his cycle, but it proved a failure. Two or three isolated attempts to compound the Diesel engine were made later on by others in both Germany and England, but these too petered out. Sperry took out a patent on a compound engine as long ago as Dec. 10, 1892. Of late the development work has been carried on energetically, one experimental model having followed another, until the essential problems are believed to have been fully solved.

Sperry's contention is that the simple engine of the Diesel type must necessarily be excessively heavy, because the cylinders, pistons and connecting rods have to be built sufficiently strong to withstand the enormous initial pressures of the power stroke, but because these pressures are maintained only for a very small fraction of the stroke, the parts of great weight and strength are poorly utilized. By allowing the expansion to occur in two successive stages, the high pressure cylinder, which must be very strong, can be made quite small, so that its weight will not be very great, and the low pressure cylinder and its accompanying parts, which must be large, can be made relatively light.

Indicator Cards

Consider the Diesel indicator card Fig. 1. Draw the vertical line *XY*, and it is easy to see that the expansion pressures to the left are high, whereas those to the right, especially following the dotted extension line of expansion, are low, and could advantageously do their work in a low pressure cylinder. The vertical line *XY* also divides the compression into two stages, low and high, the latter taking place in the combustion cylinder proper as a second stage. No air compressor for pressures of 500 lb. per sq. in. accomplishes its work in a single stage; there are at least two stages. The old single stage compressor has been discarded and replaced by the modern two stage compressor.

Supercharging or compressing in two stages also has the advantage that the temperature range of each compression chamber is greatly reduced. In the simple Diesel, as the compression ratio is in the neighborhood of 15:1, the compression space approximates a very flat cylinder which has a very large surface area in proportion to its volume. By referring to the sectional view of the engine and taking account of the fact that the upper end of the piston stroke substantially coincides with the plane of the joint between the cylinder block and the head casting, it will be seen that the compression space in the Sperry engine is hemispherical in the main, but also includes a passage to the inlet and transfer valve at one side. From the standpoint of ratio of surface area to volume this compression space is certainly a good deal better than that of the standard Diesel engine.

No Air Compressor for Fuel Injection

One of the difficulties with the standard Diesel, which is especially bothersome when it is attempted to build engines of this type in small units, is the need for an air compressor for compressing the air used for injecting the fuel. Pressures of nearly 1000 lb. per sq. in. are used, and the compression is usually effected in three or four stages. This compressor not only adds greatly to the weight and complication of the engine, but also materially reduces its mechanical efficiency. Vickers in England has dispensed with compressed air injection and uses instead what is known as solid injection, the fuel being forced into the compression space in a solid stream by piston pressure. It is claimed by the champions of air injection that much cleaner combustion is obtained where that method is used, but the fact that Vickers engines are installed in many motor ships shows that the solid injection principle is practical at least.

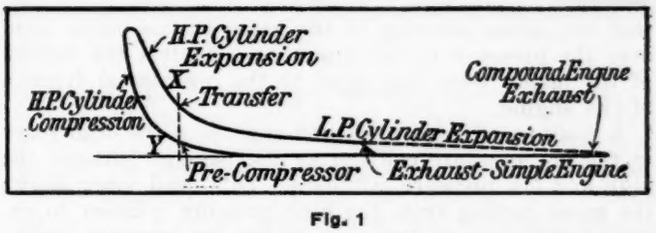
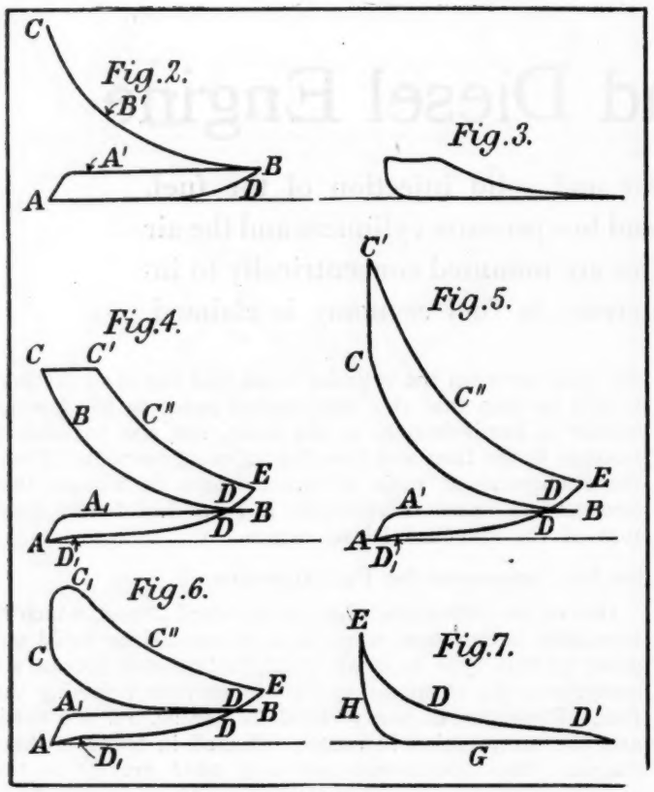


Fig. 1

Sperry uses the solid injection principle, and claims that, since the compression space is not shallow as in the simple Diesel engine, the injected fuel has to pass through a bulky mass of highly heated air before it can strike a wall, so that the difficulty resulting from the fuel stream coming in contact with relatively cool walls, which has been experienced with simple Diesel engines using solid injection, is eliminated in his engine.

Six-to-One Ratio of Piston Areas

In his A. S. M. E. paper Sperry says that instead of expansion ratios of 3 or 4 to 1, as in the automobile engine, and about 12 to 1 in the Diesel, the expansion ratio in his engine can be made as high as 120 to 1. In an automobile engine the pressure in the working cylinder at the moment the exhaust valve opens, if the engine is operating under full load, is between 50 and 70 lb. per sq. in., and in a simple Diesel engine it is about the same. A gain in power and efficiency evidently would be reached if the charge were further expanded to such a pressure



Figs. 2-7

that the excess pressure of the gases on the piston head over the pressure of the atmosphere against the bottom of the piston were just equal to the mechanical friction of the engine.

A weak point in all compound engines is the dead space in the low pressure cylinder or the passage between the high and low pressure cylinders. This dead space allows the gases coming from the high pressure cylinder to expand before they do any work on the low pressure piston, and, therefore, constitutes a source of loss. Sperry shapes the compression space of his high pressure cylinder so that it extends partly over the low pressure cylinder and is cut off from the low pressure cylinder by the transfer valve, which makes for a small dead space. He has, moreover, hit upon another means of practically eliminating clearance losses.

The Compound Cycle

Fig. 2 shows the cycle card without fuel, taken from a high pressure cylinder of a 10 to 1 compound engine, that is, an engine with a low pressure piston having 10 times the area of the high pressure piston head. The air, after having been pre-compressed, enters the cylinder at *A* on the outstroke of the piston, at a pressure of about 113 lb. per sq. in., giving a pressure line *A'*. At point *B* the inlet valve closes, and during the instroke the compression proper starts and rises along *B'* to Diesel values at point *C*. There being no fuel injection, the receding stroke brings the pressure down on practically the same line *B'* to point *B*. Here the transfer valve opens, and the gases pass during the instroke to the low pressure cylinder as shown by line *D*. This is the outstroke of the low pressure piston, the pressure dropping to a trifle below atmosphere before the exhaust valve opens. The valve remains open during the whole of the next stroke of the low pressure piston. This cannot be shown on the high pressure card, but is brought out on the low pressure card Fig. 7.

Fig. 3 is the air pump card, representing the first stage of the compression, which delivers the air to a small receiver, from which it passes during the inlet stroke along line *A'* of Fig. 2. This is virtually a power stroke, and thus some of the power lost in the first stage compression is recovered here.

Fig. 4 is the same as Fig. 2, except that fuel has been injected, and shows the slow combustion of the regular Diesel cycle, common to all early cards of these compound engines, where from point *C* a perfectly level line is often drawn to point *C'*, which marks the point of cut-off. The gases then expand on line *C''* to point *E*, where the transfer valve opens and the gases continue their work of expansion on the low pressure piston, as indicated by line *D*. When the exhaust valve opens, at point *D*, the pressure within the low pressure cylinder is only slightly above atmosphere. An objection to the simple Diesel engine is that heat is added to the charge after the piston has moved away from the top dead center position and is approaching the point of exhaust opening.

Operates as Constant Volume Engine

Mr. Sperry states that a research extending over a year and a half led to the discovery of a method by which detonation can be invariably secured. He does not say what this method consists in, but it is obvious that if the fuel were injected during the compression stroke before the temperature of the air became sufficiently high to ignite it immediately upon its entry, then detonation would result as soon as the air temperature reached the ignition value. In an English report on researches on Diesel engines carried out during the war, the statement is made that detonation was encountered which at times was rather distressing, and that it was very desirable to eliminate this detonation, but that it could not be done without at the same time lowering the fuel efficiency. Sperry, however, claims to have found that the thermodynamic efficiency is higher in the case of high detonation diagrams than in most of ordinary ones, and he has therefore sought to "harness and utilize" to the full the detonation phenomena which are such a bugbear to the automotive engineer.

Fig. 5 is a typical card taken under the same conditions and from the same engine as Figs. 2 and 4, exhibiting "detonation." When operating in this way the engine also gives a very much truer Carnot-cycle card. All recent running of the compound engines has been in accordance with this card. One of the achievements of high-intensity

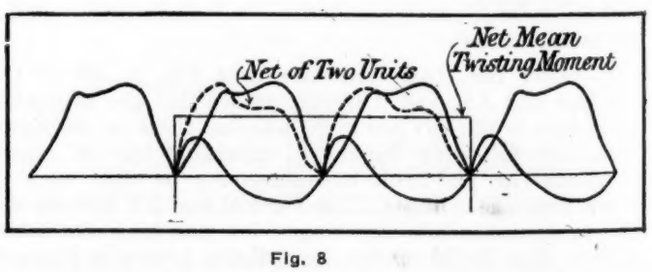
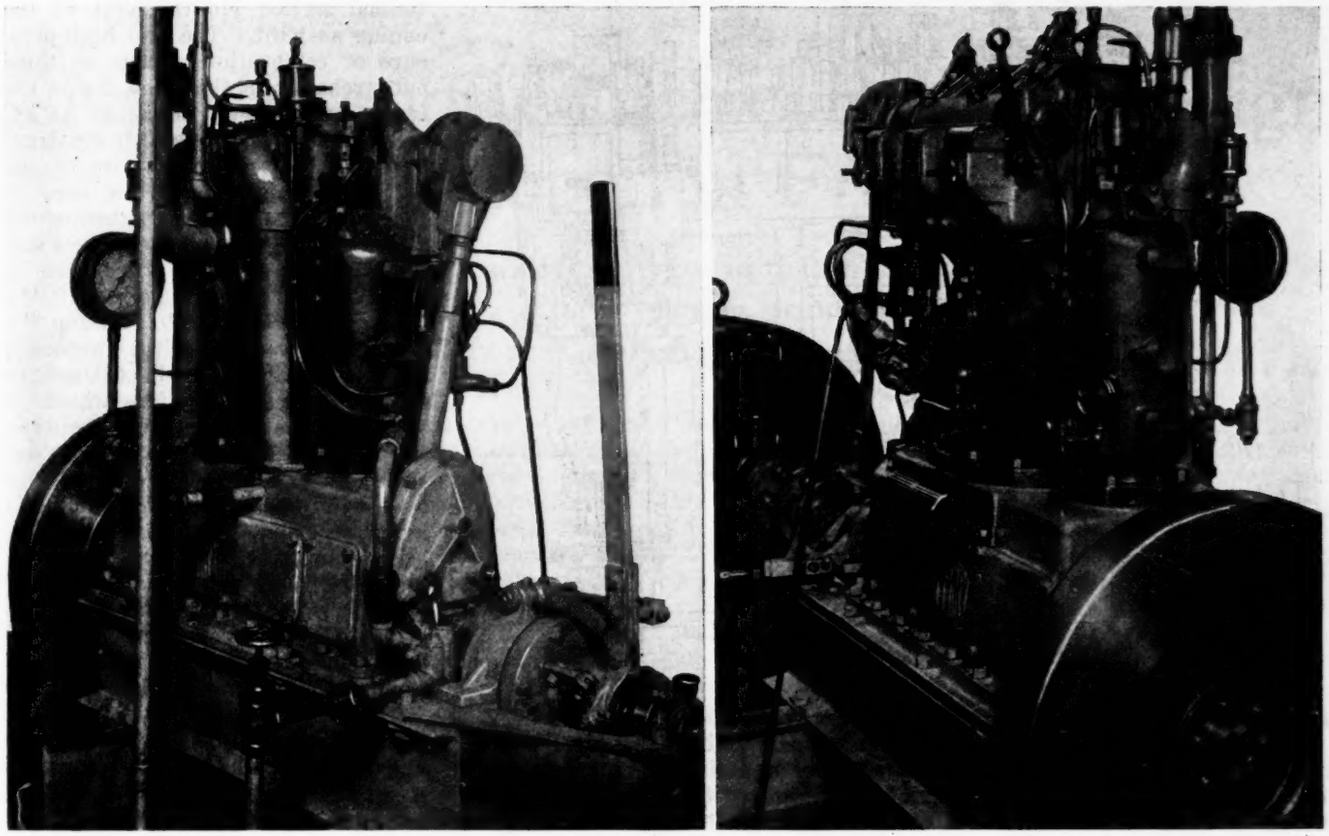


Fig. 8

combustion is better thermal efficiency and a still further reduction in the exhaust temperatures. The engine with this type of card is changed from a constant pressure to a constant volume cycle engine, which change is claimed to free it from all speed limitations. The detonation characteristics, *e.g.*, the vertical rise on the diagram, persist even at very high speeds. This card also insures operation at lower fractional powers without indication of carbon deposits. Fig. 6 is given as showing the range of control of the peak and shape of the card at will under the same operating conditions and with the same spray nozzle. Referring to Figs. 5 and 6, the peak pressures given by these cards may seem high, but they are said to



Two views of Sperry compound Diesel engine for marine use

be not as high as the pressure often encountered in the cylinders of gasoline engines, and the factors of safety provided easily take care of the stresses caused by these pressures.

Avoiding Transfer Losses

A complete solution of the problem of avoiding losses due to the low pressure cylinder clearance is said to have been found in a modification of the process of cushioning —closing the exhaust valve at a pre-determined point before the outstroke end, trapping a little of the hot gases and cushioning them up to the transfer pressure so the transfer valve opens under conditions of equal pressure on each side. There is, therefore, no flow of gases except that due to the slow starting of the strokes of the two pistons. There are practically no losses sustained in cushioning; the power of compression is returned very completely on expansion. Cushioning is credited with the additional advantages of preventing all erosion due to high velocities of the hot gases over the transfer valve seats. These seats are jacketed and are said to remain smooth, bright and perfectly sealed over long periods.

Compounding is said to completely suppress all pre-ignition, because the first part of the compression occurs outside the combustion chamber and the work of the Bureau of Standards has shown that the pre-ignition must occur early in the compression stroke in order to cause really dangerous pressures. No safety valves or pressure relief valves are therefore required or fitted.

The Transfer Valve

The transfer valve, considered as an exhaust valve, is here called upon to handle much hotter gases than ever before. A difficult situation is therefore presented. Are special materials necessary and how can the valve successfully perform this duty? It is known that the exhaust valves of the Liberty motor run red hot, and the stems white hot, and yet they are handling gases of lower temperature than are here present. Mercury cooled valves were originally provided and have now stood on the shelf unused for some years, as neither of these expedients is found necessary, nor are any but ordinary materials required. It must be remembered that compression in the compound engine is by the two-stage method. Air is admitted to the combustion chamber under comparatively high pressure, and although it is warm, yet with each doubling in pressure its cooling powers are doubled. Air at 100 lb. per sq. in. thus has seven times the cooling power of atmospheric air, as seven times the number of molecules come in contact with the valve for cooling in a given time. The part through which the air enters the high pressure cylinder is in line with the transfer port, and the induction valve itself rides on the back of the transfer valve in the form of a hollow sleeve *I* (Fig. 9) seated directly on the top of the transfer valve *T*. The back of the transfer valve is provided with greatly enlarged radiating and cooling surfaces presented to this cooling air, and powerful convection currents are constantly acting when sealed.

Now in following out the cycle it will be noticed that this is the very step that follows directly on the heels of the transfer of the hot gases (*D*, Fig. 2) and continues throughout the next quarter cycle (see *A'*, Fig. 2), and through the entire descent of the high compression piston. The transfer valve is intensely heated on its under side during the transfer stroke, but it is also intensely cooled on its upper side, which has a surface area five times as great, and the result is said to be that the mean temperature of the valve is only about half as high as that of the Liberty engine exhaust valve, not nearly approaching red heat. The seats of these valves are said to give no trouble, because they are backed by ample water jackets. They need to be ground in only very rarely.

As to the proper ratio for compounds, engines of 10:1

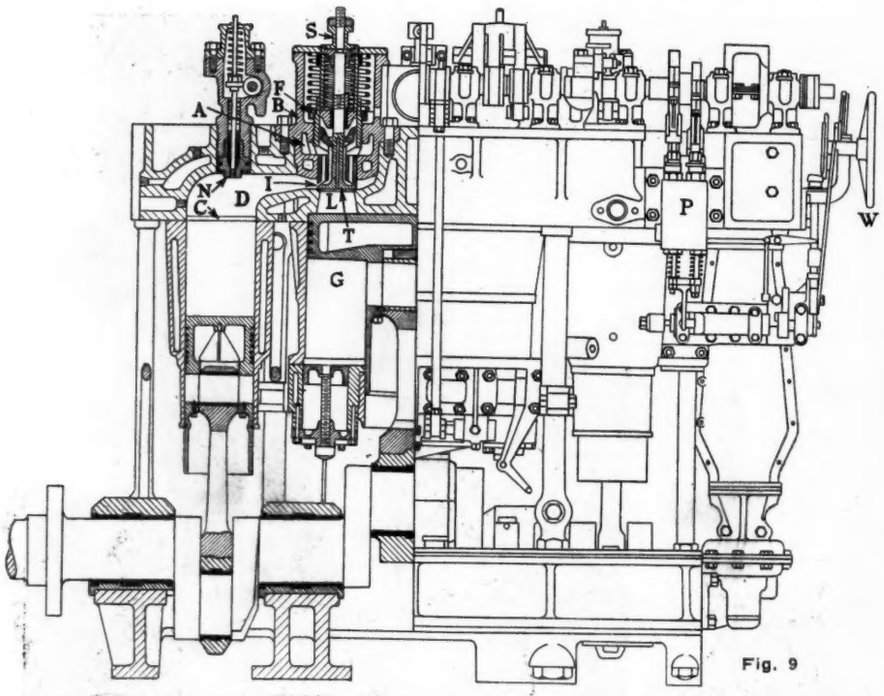


Fig. 9

ratio of low-pressure to high-pressure cylinder areas, also 8:1 and 6:1 have been made, operated and studied, the smaller ratios being at present considered more desirable. The weight factor does not change materially with changes in ratio in this region. The low-pressure piston operates two-cycle. The power distribution and the weight of the reciprocating parts both equalize best at about 6:1. This makes a perfectly balanced unit, the end masses equalling and also moving oppositely to the central. The two full power impulses following each fuel injection are also about equal. Thus full four-cylinder performance is secured with only three cranks, and two extra power impulses are delivered on the induction stroke (see line *A'*, Fig. 2) making six power impulses for each cycle.

Now as to the construction of the compound, Fig. 9 shows an elevation (to the right of the center) and longitudinal section (to the left) of the engine as built. The two high-pressure or combustion pistons on their out-stroke are at the ends, and in the center is the low-pressure at its extreme in-stroke. The sturdy construction is indicated by the size of the crankshaft, approaching the bore of the combustion cylinders themselves. The fuel pumps *P* and the control and manipulating wheel *W* are shown in elevation to the right. To the left the large clearance dome *D*, forming the combustion chamber of the compound, stands out in marked contrast to standard Diesel practice, which is shown by the little space *C* between the solid horizontal line just above. The dome is large and forms an upward extension of the combustion cylinder, extending also to the right in a large sweep surrounding the transfer valve *T* which seals the transfer port *L*. The sleeve-like induction valve *I* is shown seated on top of the transfer valve and is controlled by the cam-operated fork *F*. The transfer valve and sleeve are lifted by a fork not shown, located in thimble *S* near the top of the stem. The first stage annular compression pump *G* surrounding the trunk piston below the low-pressure piston proper delivers its air to a small receiver, which in turn discharges to the cored port *A* surrounding the induction sleeve *I*, the cooling action of which has been described. The little balancing cylinder *B* sustains a permanent connection with the low-pressure cylinder. The solid-fuel injection valve and nozzle *N* are placed approximately over the center of gravity of the large masses of air in the clearance dome *D*.

It is understood that the two high-pressure cylinders are operating four-cycle, one 360 deg. back of the other, discharging alternately into the low-pressure, which therefore works two-cycle and delivers power on each down stroke.

The Soldier Bonus

THE following statement has been issued by Joseph H. Defrees, president of the Chamber of Commerce of the United States, with reference to the proposed certificate plan for paying the soldier bonus:

"A general bonus paid through certificates is just as objectionable, from the point of view of the Chamber of Commerce of the United States, as such a bonus paid in cash. The organizations participating in the national chamber's referendum, which closed on Feb. 21, were as unmistakable in their opposition to a certificate plan as to a cash plan. They cast 1221 votes against a general bonus in either form and only 467 votes in favor.

"The chamber's opposition is to a general bonus, however paid. The chamber has not opposed a bonus merely on account of the amount of money that is involved. Attention has been called to the money requirements because of their importance and the financial problems and consequences they entail.

"Some features of the certificate plan now under consideration by the House Committee on Ways and Means are even more objectionable than the original bonus bill. It is proposed that certificates should be used as collateral for loans at banks and such loans should be rediscounted at the Federal Reserve Banks. Such a purpose means return to war conditions under which the reserve banks held large amounts of loans secured by Government war obligations. One of the problems of readjustment has been to get this paper out of the reserve banks and other paper of similar kind out of other banks. Great progress has been made, but this progress will be undone by the new proposal.

"Loans of this character have no place in the commercial banking system. They found their entry only in a war emergency. No loans should go into the Federal reserve system except such as are speedily and surely self-liquidating. Violation of this principle means inevitable inflation and other evils which are sure to follow violation of sound banking principles.

"It may be expected that evil results of such a plan as has been proposed will be increased as details are announced—such details as the terms of the loans and the rate of rediscount."

A New Friction Clutch of Radical Design Developed in France

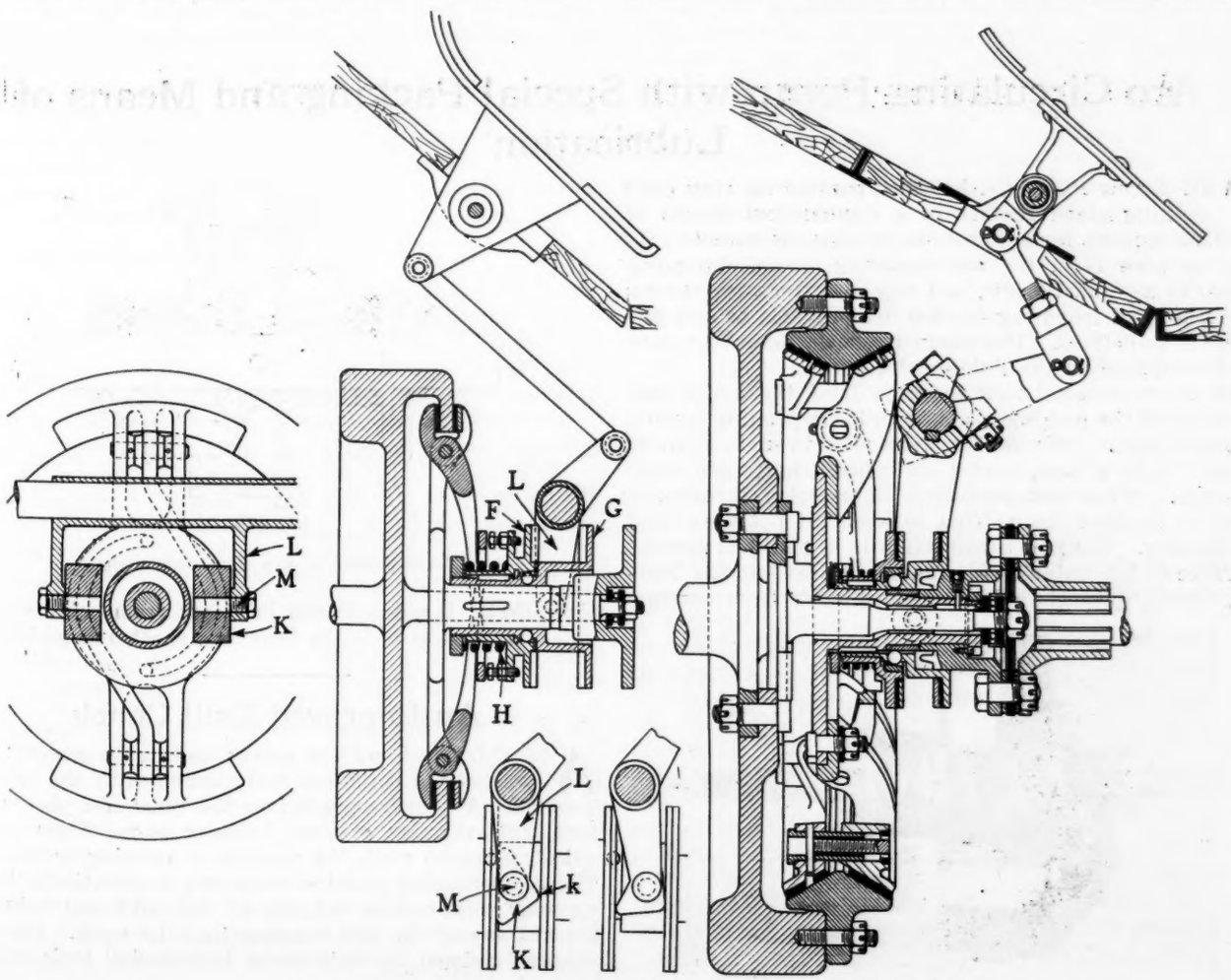
Contrary in action to the ordinary type in that the clutch is engaged by increasing foot pressure. The advantages claimed for it are: smoothness of action, absence of any drag, and ease of adjustment and gear shifting.

A NEW friction clutch for which remarkable softness of action is claimed has been brought from France by the Framerican Industrial Development Corp. It is known as the Baudoux clutch and the exclusive manufacturing rights have been acquired by Schneider & Cie., the well known munitions makers, who also manufacture gasoline omnibuses, mine locomotives, canal boat tractors, etc.

In the ordinary friction clutch as now used on automobiles and motor trucks, the clutch is forced into engagement by a spring. When the clutch is out, the driver compresses this spring by pressing on the clutch pedal, and when he wants the clutch to take hold he reduces his pressure on the pedal. It is much more difficult to gradually reduce the pressure of the foot acting against a strong spring, than it would be to gradually increase the pedal pressure, and it is little wonder that, especially in the case of unskilled drivers, the clutch often takes hold by jerks or has what is called a fierce action. Soft clutches are particularly desirable in such vehicles as motor omnibuses, which start and stop continually and which, on account of their great weight, are naturally hard to accelerate.

In the Baudoux clutch, the force that engages the clutch is not that of a spring, but the direct pressure of the driver's foot on the clutch pedal. The operating action is very much like that of a brake, the degree of application of which can always be plainly felt. The clutch is being made in two forms, one a sector clutch suitable for very light vehicles, and the other a double cone clutch, which can be made in very large sizes if desired.

Referring to the illustrations of the sector type herewith, the flywheel rim is made with an inward flange which serves as one of the friction members. On the clutch pilot shaft



Cross sections of Baudoux clutch as built for light and heavy vehicles

is carried the hub of the driven member. This driven member is in the form of pincers gripping the driving flange on the flywheel. One arm of the pincers is stationary, while the other arm is pivoted on the stationary arm. The outer ends of the pincer arms form the clutch sectors which engage the flange on the flywheel rim.

The pressure of the operator's foot is transmitted to the free arms of the pincers by means of the clutch collar. It is the motion of the clutch collar toward the engine that produces engagement of the clutch. The clutch collar is positively locked in its successive positions by a locking mechanism.

The automatic locking mechanism comprises essentially two flanged sliding collars, F and G, sliding one upon the other in such manner that the distance between the two flanges is increased or decreased. The collar G, which slides directly upon the hub of the driven clutch member, is provided with a series of recesses on its circumference, in which are located steel balls. The other collar, F, has a conical counter bore bearing on the balls, by reason of the pressure exerted by the light spring H. This spring is lodged between flanges on both of the collars. Owing to the wedging action of the conical surface on the steel balls, pressing them against the hub of the clutch driven member, the sliding collars cannot recede to the right. The two sliding collars and the hub of the driven member are provided with splines, and may therefore slide longitudinally one upon the other without angular motion.

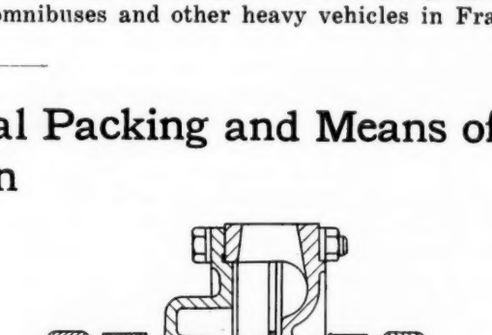
When the clutch is to be disengaged it is, of course, necessary to relieve the wedging acting on the steel balls. The release is effected by pressing simultaneously to the left on the left flange F and to the right on the right flange G. The recession of the two sliding collars releases the balls and consequently allows the assembly of collars to slide on the hub of the driven member. This result is obtained automatically by the effect of the spacer K which operates as follows: The forked lever L, which bears on the flange F for the engagement of the clutch, applies its effort through the intermediary of two triangular cams K on trunnions M. The contour of these cams is shaped to give the following result: For the clutch engaging action (right to left) the long side of the cam is forced against the left-hand flange and the opposite point is out of contact with the right hand flange. For declutching, the pressure toward the right on the trunnion M brings the point K of the cam in contact with the flange G and in consequence of the adherence of the steel balls, effects a rocking motion of the spacer K. This action on the clutch yoke therefore forces the two sliding collars apart, and since the force on the yoke is toward the right, the sliding collar assembly is withdrawn toward the right and the clutch thereby disengaged. The two flanges F and G are provided with hardened facings, and the pressure of the point of the cams is distributed over a large area. Adjustment of the clutch can be made by means of the adjusting screws plainly shown.

Among the advantages claimed for this design of clutch are great smoothness of action, due to causes already explained; absence of drag, due to the small number of parts and the precision with which adjustment can be effected, and, finally, ease of gear shifting, by reason of the small inertia of the driven member. The clutch is in use on motor omnibuses and other heavy vehicles in France.

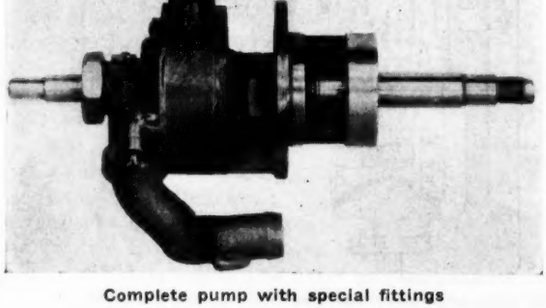
Aro Circulating Pump with Special Packing and Means of Lubrication

THE Arrow Pump Co. has incorporated its ring oiled packing gland feature in a standardized design of circulating pump for automobiles, trucks and tractors. As may be seen from the accompanying views, the pump proper is a standard unit, and special fittings for the inlet, outlet and mounting bracket are provided to suit different installations. The pump is shown herewith ready for installation on the Paige motor.

The cross sectional view shows in detail the Arrow construction of the packing gland, with its ring oiling method of lubrication. This construction is claimed to entirely prevent leaky glands, scored and pitted shafts and worn bearings. With this method of lubrication it becomes practical to place the packing between the hot water and the bearing. The new construction is intended to prevent entrance of hot water or foreign substances into the bearing, thereby protecting bearings and shaft from destructive effect. It prevents the lubricant from being washed out, and confines it to the bearings, shaft and packing.



Cross section of Aro circulating pump



Complete pump with special fittings

An Improved Drill Chuck

A DRILL chuck with a safety feature to prevent the breaking of drills has been developed by the SaveAll Tool Co. A positive pin drives the collet and shears before drills, reamers, etc., can break or burn. Tools can be quickly changed while the machine is running or stopped. The compensating positive collet lock automatically takes up wear, eliminating end play of the collet and reducing the chances of the tool hogging into the work. One advantage claimed for this chuck is that dull tools cannot be used.

Aircraft Engine Experience as a Basis for Automobile Engine Development

Super-compression and over-dimensioning of engines as an aid to fuel economy. Its possible application to "gearless" cars. An improvement of the starting torque would make the internal combustion engine flexible. Mr. Dechamps gives the results of actual tests as well as his calculations.

By H. Dechamps

THE enormous development of aircraft during the war in all the participating countries has borne fruit in the further improvement of internal combustion engines, in that the weight and fuel consumption have been reduced and the specific output increased in entirely unexpected proportions. Although the service conditions of automobile and aircraft engines are materially different, there is so much in common between the two that it is good policy for automobile engine designers to heed the lessons of aircraft engine experience.

It is not the intention in this article to discuss details of construction, particularly in view of the fact that many of the improvements which were found absolutely necessary in aircraft engines have since been applied to automobile engines. Reference is here made to such features as the location of valves in the cylinder head, the hemispherical formation of the compression space, the complete machining of the compression space, the use of steel and aluminum in place of cast iron for cylinders, improved means for heat disposal by the use of aluminum pistons, the increase in the number of cylinders and the better balance of the moving parts.

Increasing Compression

These various improvements, the advantages of most of which can be checked by means of comparatively simple theoretical calculations, have made it possible to use a higher compression without incurring danger that the engine will knock. The favorable effect of an increase in the compression ratio on the output and fuel economy is well known. It is probably less well known that the gain is actually greater than theoretical considerations would lead one to expect. Very accurate tests on a Benz engine, whose compression ratio was increased from 5 to 5.8 by the installation of longer pistons, gave the results compiled in the following table, those for a compression ratio of 5 being placed equal to unity:

Compression ratio.....	1:5	1:5.5	1:5.65	1:5.8
Theoretical output.....	1	1.045	1.055	1.065
Actual output.....	1	1.065	1.100	1.125

This extra gain in output, beyond what would be expected from the increased pressure and temperature drop, is due to an improvement in the efficiency of combustion with increased compression, effected more rapidly, as is further attested by the fact that the gain increases rapidly at higher speeds.

Unfortunately, the permissible compression is rather closely limited by the tendency of the engine to knock and the demands as regards smooth running are much more severe in the case of automobile than that of aircraft engines. This is not the place to go into all the different causes of knocking, but it may be pointed out that this factor is a test of the ability of the designer. Whereas some engines begin to operate roughly with a compression ratio of only 4.5, the more capable designer succeeds to force the compression up to 5.8 without the engine inclining to knock. Aside from the timing of the valves, which is of considerable influence, the cooling arrangements are determining. A chain proverbially is no stronger than its weakest link, no matter how strong the others may be. In connection with cooling the weak link is the particular point whose overheating causes preignition, and whose determination and elimination is a problem for the engineer. If the rules which in the foregoing were referred to as well known are given due consideration, the weak link which causes knocking is usually the spark plug. In determining the location of the latter it is impossible to be too careful that the spark plug boss is effectively cooled by water all around, and that the walls of the boss are thin enough so as not to permit of too great heat accumulations. The selection of the spark plug also is of great importance. There is as yet no universal plug, because the plugs manufactured for engines with super compression, which have excellent heat radiation facilities, become easily sooted when the engine is idling, as under that condition the temperature of the plug insulator is too low to burn any oil that collects upon it. In connection with these very sensitive engines, more exacting demands must also be made on the workmanship, as a single passage on any cylinder boss which is clogged with core sand or iron suffices to cause steam pockets to be formed and overheating to result, and thus lessen the value of the whole engine.

Fuel Economy

In the case of commercial vehicles, where economy is imperative, it is possible to effect a considerable economy in fuel consumption by an increase in compression ratio, in combination with the use of a suitable reduction ratio between the engine and rear wheels. A departure in this direction was made by the Bayerische Motorenwerke, who are furnishing a 45-hp. truck engine with a guaranteed fuel consumption of 220 grams (0.484 lb.) per horsepower-hour, which as compared with consumptions of 300 to 350 grams (0.66 to 0.77 lb.) represents a saving of approximately 30 per cent. This result has been accomplished by forcing the compression to a particularly high point, which was rendered possible only by throttling the engine so as to keep the maximum explosion pressures and temperatures within the limit found in conventional engines.

Special interest attaches to the theoretical proof of the economy which it is possible to secure—which was first developed by Prof. Weisshaar—for the reason that it is not easy by other than mathematical reasoning to arrive at the conclusion that such advantages can be achieved by super compression and throttling.

Let us denote by

G the weight of a cylinder charge consisting of
G_f fresh mixture and
G_r spent gases from a previous explosion,
V_h the piston displacement,
V_c the compression space,

$r = \frac{V_h - V_c}{V_c}$ the compression ratio,

p_h the maximum explosion pressure,
p_r the pressure at the end of the power stroke,
T_h the absolute maximum temperature of the explosion,
T_r the absolute temperature of the spent gases,
R the gas constant;

we then have, $G = \frac{p_h V_c}{R T_h}$

$$G_r = \frac{p_r V_c}{R T_r}$$

By subtraction,

$$G_f = G - G_r = V_c \left(\frac{p_h}{R T_h} - \frac{p_r}{R T_r} \right)$$

From the definition $r = \frac{V_h - V_c}{V_c}$

it follows that $V_c = \frac{V_h}{r - 1}$

and by substituting this value we obtain

$$G_f = \frac{V_h}{r - 1} \left(\frac{p_h}{R T_h} - \frac{p_r}{R T_r} \right)$$

If we apply to an engine with increased compression the same designations and add an index figure a, we obtain for this type of engine—

$$G_{fa} = \frac{V_{ha}}{V_h} \left(\frac{p_h}{R T_h} - \frac{p_r}{R T_r} \right)$$

The ratio of the charges of the two engines is then

$$\frac{G_{fa}}{G_f} = \frac{V_{ha}}{V_h} \frac{r - 1}{r_a - 1}$$

If we assume that the mechanical efficiency as well as the efficiency of combustion of both engines are the same, we obtain for the ratio of the outputs,

$$\frac{N_a}{N} = \frac{G_{fa}}{G_f} \frac{\eta_{ta}}{\eta_t}$$

where η_t represents the thermal efficiency. By introducing the values for the degree of filling with fresh gases we obtain

$$\frac{N_a}{N} = \frac{V_{ha}}{V_h} \frac{r - 1}{r_a - 1} \frac{\eta_t}{\eta_{ta}}$$

If both outputs are equal we have $N_a/N = 1$ and

$$\frac{V_{ha}}{V_h} = \frac{r_a - 1}{r - 1} \frac{\eta_t}{\eta_{ta}}$$

from which it follows that

$$V_{ha} = V_h \frac{r_a - 1}{r - 1} \frac{\eta_t}{\eta_{ta}};$$

that is to say, the high compression engine must have a greater piston displacement than the one with normal compression. But in order that its output may remain the same the mean effective pressure p_{ca} must be reduced by throttling.

For equal outputs we have

$$p_c V_h = p_{ca} V_{ha},$$

and the mean effective pressure for the high compression engine, therefore, is

$$p_{ca} = \frac{p_c V_h}{V_{ha}} = p_c \frac{r - 1}{r_a - 1} \frac{\eta_{ta}}{\eta_t}$$

An example will more clearly bring out the relations. Let us take a four-cylinder truck engine of 4½ in. bore and 6 in. stroke, which at 1000 r.p.m. and a compression ratio of 4.5 to 1 develops 40 hp. and consumes 0.585 lb. fuel of 17,000 B.t.u. heat value per horsepower-hour.

The piston displacement is 382 cu. in;

The compression ratio 4.5;

The thermal efficiency $\eta_t = 1 - r^{1-\gamma} = 0.41$ (assuming γ to be 1.35).

If now an engine with a compression ratio of 6 is to give the same output, since its thermal efficiency will be

$$\eta_{ta} = 1 - 6^{1-\gamma} = 0.466,$$

this must be made with a piston displacement

$$V_{ha} = V_h \frac{r_a - 1}{r - 1} \frac{\eta_t}{\eta_{ta}} = 382 \frac{6 - 1}{4.5 - 1} \frac{0.41}{0.466} = 480 \text{ cu. in.}$$

or about 25 per cent more.

In the same proportion the mean effective pressure must be reduced by throttling. For the conventional engine this pressure amounts to

$$p_c = \frac{40 \times 792{,}000}{382 \times 1{,}000} = 82.9 \text{ lb. per sq. in.}$$

In the high compression engine the mean effective pressure must be reduced by throttling to

$$p_{ca} = p_c \frac{V_h}{V_{ha}} = 82.9 \frac{382}{480} = 66 \text{ lb. per sq. in.}$$

Theoretically the fuel consumption varies in direct proportion to the thermal efficiency, and it therefore becomes

$$b_a = b \frac{\eta_t}{\eta_{ta}} = 0.585 \frac{0.41}{0.466} = 0.515 \text{ lb. per sq. in.}$$

which represents a saving of

$$\frac{0.585 - 0.515}{0.585} = \text{approximately 12 per cent.}$$

In reality the saving will be greater, as the assumption that the efficiency of combustion will be the same in the two cases does not hold, this factor being higher in the case of the super-compression engine, so that a fuel consumption of not over 0.485 lb. per horsepower-hour can be relied upon.

This calculation gives a valuable indication as to the direction in which there is a chance for the improvement of truck engines. The objection that the weight and manufacturing costs will be increased, owing to the greater piston displacement, is of little moment, as in the case of motor trucks the engine weight is not a very important factor, and any slight increase in manufacturing costs are compensated for by the saving in operating cost during a very short period. The life of such an engine, too, need not be shortened, as the specific bearing pressures can be kept low, and as the throttling in part neutralizes the influence of the super-compression on the pressure diagram. A more important feature is the increased difficulty of cranking, which, however, does not need to be considered where an electric starter is fitted. Possibly the fuel economy may be further increased by providing the carbureter with several spray nozzles and venturis, so that the engine may be fed a rich mixture when under full load, whereas when the engine is throttled to carry its normal load a second carbureter comes into play which delivers a very lean mixture.

Such a super-dimensioned and throttled engine possesses a considerable reserve of power, if the drive is sufficiently robust, as it is possible to operate it temporarily on a fully open throttle. The thought suggests itself that this may be taken advantage of by dispensing with the change speed gear. It may here be remarked, parenthetically, that this often discussed problem has lost greatly in importance through improvement in transmission design. It is true that we are still using clash gears, which according to ideas current in general mechanical practice are an exceedingly crude device, but through a long succession of improvements in design and construction material, in the clutch as well as the transmission, the formerly heavy, bulky and more or less unreliable transmission has shrunk to an unobtrusive excrescence to the engine housing, so that its elimination would not have nearly the same advantage which it would have had only a decade ago. As often happens in the history of mechanical development, time brings solutions of problems which previously staggered the most capable, when these solutions no longer are of any particular value.

A "Gearless" Car

With large cars, such as the eight-cylinder Cadillac, with its excellent clutch, one can start without difficulty on the direct drive and needs the transmission only on exceedingly steep grades and in backing. This idea of the gearless car was taken up by Maybach, who exhibited such car at this year's Berlin automobile show, with a six-cylinder engine delivering 70 hp. at 2000 r.p.m. The engine is fitted with a specially powerful electric starter, which is put in operation by pressing on a pedal, and as the clutch is not withdrawn, this starts the car as well as the engine. The starting pedal also connects to the throttle valve, opening the throttle as it is depressed, and as the ignition is then closed the engine picks up its cycle at once. A further depression of the pedal cuts out the starter. As the engine develops a very high torque, this pedal serves as the only control member for use on level roads and moderate grades. For exceptionally steep hills a "hill pedal" is provided which connects a planetary gear built into the flywheel housing into the transmission line without shock. In the intermediate position of the "hill pedal" the clutch is disengaged, so that it is possible to let the engine idle in special cases. Backing is effected entirely electrically, by reversing the starter. Even though certain objections may be raised against this solution of the problem, the boldness of the new idea must be acknowledged, which greatly facilitates the operation of the car by unskilled persons, since gear shifting is eliminated and instead use is made only of a single pedal, if we disregard the "hill pedal," which is used only in exceptional cases.

Weakness of Explosion Engines

This solution, consisting in the use of an exceptionally powerful starter, masks the inherent weakness of all explosion engines residing in the fact that they give a substantially constant torque, instead of increased torque at low speeds, like a steam engine. It is natural that the ideal solution of an explosion engine with variable torque must be matured first in the form of a stationary engine, which is subject to fewer restrictions with respect to weight, tending, bulk, etc. If we disregard the interesting, but so far unsuccessful, experiments with mechanical changeable transmissions, as, for instance, by a change of the stroke, the most direct method of increasing the output is the use of blowers.

Aircraft engines have been very successfully fitted with blowers, for the purpose of maintaining the output at great altitudes in spite of the decreased density of the air, but the problem in connection with motor cars is an entirely different one. On the contrary, very remarkable results of tests on Junkers stationary two-stroke engines are to hand, where by the use of sufficiently large blowers and throttling of the exhaust ports the output was temporarily increased by from 30 to 50 per cent, which results should be taken notice of in the further development of automobile engines. The chief objection raised to this construction is that it gives a machine which normally can be used only as a throttled motor and is therefore not fully utilized. This argument is not entirely valid, as the parts are so proportioned that the engine would not stand operating continuously under full load, as regards both mechanical stresses and heat disposal. Still more interesting in this respect is the Diesel engine of the Sulzer experimental locomotive, which on starting off is caused to produce a very high torque by overfilling with air under pressure. Owing to the high consumption of compressed air and the cooling requirements, this method of operation can be continued for only a short period, until from one-quarter to one-half the normal speed has been attained. From that point on both fuel and compressed air are blown into the cylinders, and as ignition of the charge is effected, a very "full" indicator diagram is obtained, corresponding to an overload. This is continued until the train has reached its full speed, whereupon the engine output is reduced to its normal value.

Extended laboratory tests make this method of operation appear satisfactory, but in practice so many detail difficulties must be overcome that years will be required to ripen a project of this sort.

Future of Research

In the case of the automobile engine this plan seems to have greater possibilities. The slight extra weight of the blower is compensated for by the elimination of the transmission; the stresses in the rear axle are not increased, and considerations of weight do not prevent a strengthening of the engine cylinders and drive mechanism. The flexibility of the engine and the form of the diagram in case of super-charging, as well as the influence on the inflammability with mixtures of different proportions are questions that still remain to be settled. An investigation of these problems would be a worthy task for American mechanical laboratories equipped with optical indicators and other suitable instruments, particularly since research work in German institutions has almost completely stopped, on account of lack of means due to the economic situation. An exchange of ideas which would make available to American engineers the results of many not yet fully exploited German researches as a guide for further research work, and by which German engineers might be acquainted with recent experimental results obtained in America, could only be of advantage to the engineers of the two countries.

THE Stevenson Gear Co. has recently brought out a down-stroke model of its multiple shaper or gear cutter, complementary to the up-stroke model described in AUTOMOTIVE INDUSTRIES of Aug. 25, 1921. This machine is known as the Model 6-A and resembles the vertical shaper or slotting machine in general appearance and principle of operation. The principal unit of the mechanism is a special tool head which consists essentially of a series of radially disposed tools spaced about the circumference of the blank to be cut. The machine operates in the same manner as an ordinary vertical shaper except that the tools are held stationary and the gear blanks are reciprocated past the tools.

Stability of Two-Wheeled Tractors

Usually in these tractors the torque removes weight from the drive wheels and transfers it to the implement on which rests an extension frame. The drawbar pull has the contrary effect if the drawbar is below the wheel axis. Mr. Heldt discusses other phases of this problem in this article.

By P. M. Heldt

THERE has been a good deal of discussion on the subject of the transfer of weight from the front to the rear wheels when a rear wheel-driven, four-wheel tractor has power applied to its wheels, and the fact is now thoroughly established that when the front end leaves the ground as a result of this effect, it is around the rear axle center line that the motion takes place. On the other hand, comparatively little has been said on the corresponding effect in a two-wheeled tractor. The reasons probably are that so far there have been only a few models of two-wheeled tractors on the market, and that in no case is there any danger of serious accidents when a machine of this type is pulling heavily.

Since action and reaction are always equal and opposite, it is quite obvious that the tractor, when power is applied to the wheels for forward motion, tends to turn backward with exactly the same torque or turning effort as that with which the wheels turn forward. To hold the tractor frame from rotating it is provided with a rearward extension, which generally rests upon the implement, but in some cases upon a two-wheeled truck furnished with the tractor. The product of the downward pressure upon the implement or truck, into the perpendicular distance from the axis of the tractor axle to the center line of this pressure, is equal to the torque on the driving wheels, and is known as the torque reaction. Of course, if the center of gravity of the tractor is located ahead of the driving wheel axis, a part of the weight of the tractor will also press down on the implement.

Simple illustration showing how ground pressure can be reduced by torque reaction

It is a general principle of mechanics that when a system is in equilibrium all outside forces on it vanish. The "system" here considered is the tractor, and the outside forces take effect at the center of gravity, at the points of support of the tractor and at the drawbar hitch.

When the tractor is at rest, with no power on its drivers, there are three forces active which must be in equilibrium. The force of gravity W acts at the center of the gravity of the whole tractor, and is balanced by the ground reaction P against the wheel and the reaction p of the implement against the frame extension, as in Fig. 1. The moments around any axis vanish. For instance,

$$Wl = pL \text{ and } Pl = p(L - l)$$

Referring to this Fig. 1, it will be seen that the sum of the two reactions is equal to the total weight of the tractor, and the reactions are inversely proportional to the distances of the points at which they occur, to a vertical line through the center of gravity of the tractor. As in this case the center of gravity is very near the wheel axis, the pressure of the wheel on the ground is far greater than the pressure of the frame extension on the implement.

If now power is applied to the tractor and a load is hitched to it, the previously existing outside forces are considerably changed in magnitude, and there is one more outside force acting on the tractor, namely, the reaction to the drawbar pull at the drawbar hitch. If we designate the drawbar pull reaction by R and the rolling resistance encountered by the tractor by A, then the tangential force at the wheel rim gives rise to a horizontal reaction of the ground against the wheel (the force which prevents the wheel from slipping) which is represented by $A + R$. In order to obtain rational proportions we have assumed in the diagrams that the maximum drawbar pull is equal to three-fourths the weight of the tractor, and the rolling resistance equal to five-eighths this weight.

The tangential force at the wheel rim, represented by $A + R$, acting at the length of an arm r equal to the wheel radius, is balanced by a similar moment created by a reaction B at the point of contact between the frame extension and the implement, acting on a lever arm L, constituted by the perpendicular distance between the center line of this reaction and the wheel axis. We have then (Fig. 2)

$$(A + R)\, r = B\, L$$

hence

$$B = \frac{(A + R)\, r}{L}$$

This reaction is in the same direction as that due to the component of the force of gravity at this point (p); in other words, the pressure of the frame extension on the implement is increased by the torque reaction.

It has been intimated that the drawbar pull R is balanced by a fraction of the horizontal reaction of the ground on the drive wheels. But since these two forces are not in line they cannot completely balance each other. In fact, we took a moment of the reaction to the tangential force on the wheel $(A + R)$ around the wheel axis, and we must also take a moment of the reaction to the drawbar pull around this axis. In the drawings we have assumed that the perpendicular distance a of the drawbar center line from the wheel axis is equal to one-third the wheel radius r. This moment tends to raise the frame extension and is contrary to the moments due to weight and torque reaction. The reaction to this moment at the point of contact between frame extension and implement, which is denoted by C, is therefore downward. This reaction

$$C = \frac{R \times a}{L}$$

The actual pressure of the frame extension on the implement in regular operation therefore is

$$p' = p + B - C$$

where

p is the reaction at this point when there is no power applied to the tractor wheels.

B is the reaction due to the driving torque.

C is the reaction due to the drawbar pull.

The first item, p, can be decreased by moving the center of gravity of the tractor closer to the wheel axis, and vice versa. The reaction due to the propelling torque can be decreased by lengthening the frame extension, and vice versa. The reaction due to the drawbar pull can be *increased* (which has the same effect as decreasing either of the two items) by placing the drawbar hitch lower. In general, smallness of pressure on the implement is desirable.

It is obvious that the pressure of the driving wheels on the ground when the tractor is under load depends also upon three items—

$$P' = P - B + C$$

That is, the pressure of the driving wheels on the ground when the tractor is under load depends upon the tractor weight component upon the wheels, an item depending upon the torque and an item depending upon the drawbar pull and the height of same.

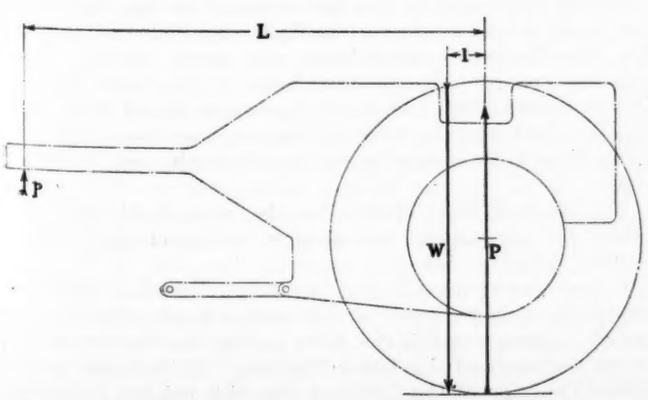


Fig. 1

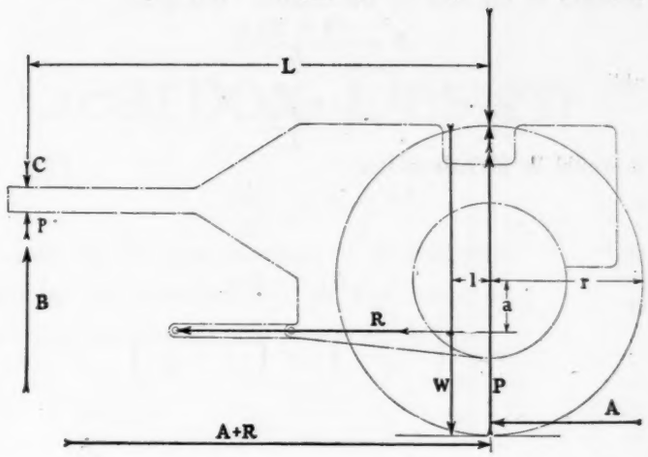


Fig. 2

That the drawbar pull adds to the load on the drive wheels if the drawbar is below the wheel axis is easily shown. In Fig. 3 are sketched the wheels and tractor frame in a diagrammatic manner, and the reaction of the implement on the drawbar, C B, and the downward pull, A, B, which must be exerted on the end of the frame extension to keep the frame in equilibrium, are drawn in. The resultant of these two forces, O B, takes the form of axle pressure on the wheel bearings and must be balanced by an equal and opposite reaction O D of the ground of the wheels. This reaction is inclined and has both a horizontal and a vertical component. The horizontal component O E is part of the resistance to slippage of the wheel on the ground, while the vertical component E D constitutes an increase in the vertical reaction of the ground on the wheel, and hence in the pressure of the wheel on the ground.

We want the greatest possible pressure of the wheels upon the ground, because upon this pressure depends the maximum drawbar pull of which the tractor is capable. This means that B (Fig. 2) ought to be made small, by using a long frame extension or small wheels, and C large, by placing the drawbar low or making the frame extension long. Of course, the greatest pressure of the drivers on the ground that can possibly be obtained is equal to the total weight of the tractor. The sum of the reactions at the point of ground contact and point of contact with the implement is always equal to the weight of the tractor—

$$(p + B - C) + (P - B + C) = (p + P) = W$$

If it were possible to make B and C equal then the pressure of the drivers on the ground could be made inde-

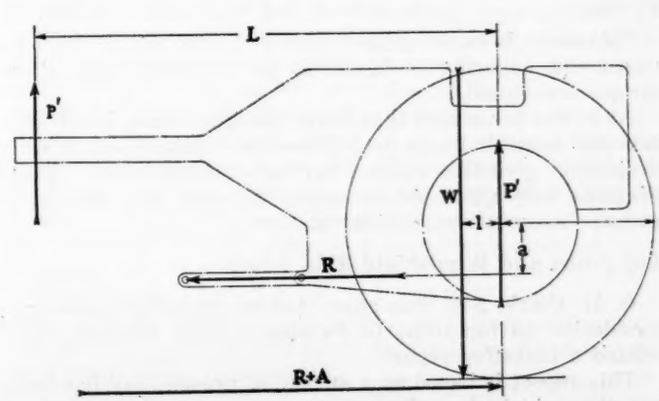


Fig. 4

pendent of the load on the tractor. But since

$$B = \frac{(A + R)\, r}{L}$$

and

$$C = \frac{R \times a.}{L}$$

it would be necessary that

$$\frac{(A + R)\, r}{L} = \frac{R\, a}{L}$$

or

$$(A + R)\, r = R\, a$$

or

$$a = r\left(\frac{A + R}{R}\right) = r\left(1 + \frac{A}{R}\right)$$

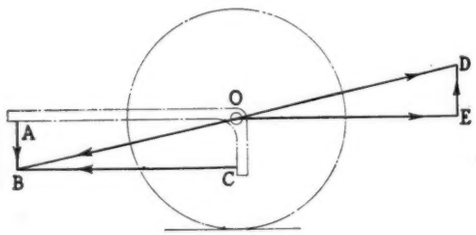


Fig. 3

That is, since in practice A is nearly equal to R, the drawbar hitch ought to be below the wheel axis a distance equal to twice the wheel radius, which is impossible. In practice, if the drawbar is located at one-third wheel radius below the wheel axis, it neutralizes about one-sixth the effect of the torque reaction in transferring weight from the driving wheels to the implement.

In Fig. 4 are indicated the resultant forces at each point where outside forces act upon the tractor. By comparing this with Fig. 1 it will be seen that the vertical pressure of the drive wheels on the ground, represented by P and P' in the two cases respectively, is reduced by 41 per cent. This figure, of course, applies only to the proportions assumed in drawing the diagrams and which have been stated in the foregoing. It would seem from this that from the standpoint of limiting draft the two wheel construction is not as advantageous as generally believed.

It may not be directly obvious to those not familiar with the method of solving problems in mechanics, how the ground pressure of the drivers can be reduced by the torque reaction. A homely illustration will make this clear, however. If a man stands on a weighing scale and then extends his arms horizontally and presses down upon some support of suitable height, the weight indicated by the scale will be reduced. If the support upon which he presses were upon another scale, then the sum of the weights indicated by the two scales would at all times be equal to the sum of the weights of the man and the support. The man's muscles then would act as a motor, tending to cause his arms to swing around their sockets, and the pressure of the hands upon the support multiplied by the length of the arms would measure the torque.

Body Standardization Work in Progress

At a recent meeting of the Passenger Car Body Division of the Society of Automotive Engineers Standard Committee it was reported that investigation showed that a center-to-center distance of 1½ in. between escutcheon plate screws was very common. As the standardization of door handle square bearing diameters was suggested, it was decided to continue the investigation. The subject was assigned for further consideration to G. E. Goddard, who will make an investigation covering escutcheon plates, door handle square bearings and the bevel on door lock bars and escutcheon plate screw sizes.

Discussion of door hinges indicated that it may be possible to standardize some features of exposed hinges, the following dimensions being submitted as desirable practice.

Type	Plate Width, in.	Thickness, in.	Screws No.	Size
Malleable or	1¾	3/16	4	No. 10
Forged	2	1/4	4	No. 12
Pressed	2	1/8	4	No. 12

Clearance between plates shall be 1/16 in. at the exposed end, tapering to ⅛ in. at the concealed end when hinges are closed.

As it was advocated that hinge pin diameters, hinge offsets and possibly hinge projections be standardized, it was decided to give this subject further consideration. E. G. Simpson was appointed to secure the necessary data and prepare a tentative recommendation.

Top Irons and Windshield Side Arms

O. H. Clark, who was appointed to formulate a recommendation on top irons in February, 1921, recently submitted a tentative report.

This report is based on a survey of present-day top iron practice, which showed a great variety of types and sizes. A careful analysis of the data, however, indicated that the great majority of top irons are made with 7/16-in.-14 United States form threads. This thread has therefore been specified and should meet with general approval. The top iron types recommended cover all general requirements. The through-the-rail type of front top iron can be used through the rail by body builders who do not wish to provide for the removal of the top iron in case the permanent or California type of top is used. This type of top iron is superior to the separate through-the-rail type of front and rear top irons inasmuch as it is not necessary to counterbore such large holes through the rail for the top iron sockets, avoiding the weakening of the top rail.

This report was discussed at the last Passenger Car Body Division meeting, but no definite action was taken. It was felt that probably only the threaded shank on the top iron can be standardized, as there are so many varying conditions that control the other dimensions and shapes, and as no one top iron can be used interchangeably on different bodies or cars.

It was suggested at the last meeting of the Passenger Car Body Division that a standard should be formulated for the shanks on windshield side arms, so that body builders can provide standard holes in the body frames. It was thought that the shank diameters should be in odd-number sizes and the holes in even-number sizes, and that there should be a definite series of lengths and threaded ends.

The Society is to circularize the windshield manufacturers for suggestions and data in this connection before further action is taken.

It has been requested that the Truck Division standardize the mounting dimensions for motor truck cabs so as to permit interchangeability. This matter has been referred to the members of the Truck Division. If it should be the general opinion of the Division that this subject should be taken up, a Subdivision will be appointed to formulate a tentative recommendation.

Improvements in Gearbox Design

Part III.

In this article Mr. Orcutt deals with factors in the production of gearboxes. He shows how weaknesses are revealed by an examination of the costs of production and offers suggestions for improvements in gearbox design.

By H. F. L. Orcutt*

IN no way are the anomalies and weaknesses of the gearbox so clearly revealed as through an investigation of costs of production. Such an investigation is specially recommended as a stimulus to reform in design and in methods of production. It will reveal that when the best running qualities are desired in proportion to its size, number of parts, and machine operations, the gearbox is a costly unit. It will reveal that a box with almost any elaboration of design necessary to secure good running qualities will be cheaper to produce than the conventional type with all its uncertainties of costs, both direct and indirect.

With regard to costs, motor car boxes may be broadly divided into two classes: Those in which the costs are known, and those in which they are unknown. The "known" class includes those boxes which are produced under well-organized conditions, where labor-saving machines are properly equipped with up-to-date tools. Wide clearances are allowed, limits are not very fine, no fitting is called for; costs of assembling are low and it is done by unskilled labor. The teeth of gears are cut with plenty of backlash, with no stoning, or "running in," and no scrap. Noisy running is tolerated, boxes are never pulled down after road tests. The costs of these boxes are low, and in many cases they give good service, but are nearly all very noisy. There is nothing in the problem of production of this class of box that is not well within the capacity of most makers of components. All the machine operations are of the ordinary class, the costs of which are common knowledge. The foregoing applies principally to the so-called three-speed box. As long as the public is satisfied with their running qualities, so long will the maker continue to supply this class of work.

Niceties in Gearbox Manufacture

The "unknown" class of gearbox might well be called the "unlimited" class as far as costs are concerned, for many makers never stop work on them until they run to the satisfaction of their road testers. They may pull them down once or a dozen times; work is put into them regardless of expense and time—the whole output of cars is often held up through faulty gearboxes. A forecast of their cost is impossible, and an estimate of what they really do cost is so involved and mixed with other costs that no exact figure can be given. Hundreds of pairs of gears have been seen in more than one motor car works which are thrown aside as scrap. In many works all costs on gearboxes after the first machining and bench work are charged either to erecting and testing, or considered a part of "on-cost." Much depends on the degree of silence that is expected. Some well-known makers are content with silent running for the constant-mesh gears only, others add the third speed. Quiet running on second and first speeds is given up altogether, and reverse gears are rarely bothered with, no matter how badly they may run. Very few indeed make any attempt to secure equally quiet running on all speeds.

Good Workmanship Reduces Assembling Cost

In boxes where the best running qualities are desired, costs are usually enhanced by inaccurate machine work. It should not be forgotten that the central idea should be so to design and make the gearbox that it will support accurate tooth contact. Limits of workmanship have been given without which the best results will not be secured in any design. These limits are adhered to by but very few makers of either good, bad or indifferent boxes. Inaccurately seated ball bearings are a fruitful source of unnecessary costs. They have a narrow face compared with the diameter. For this reason they can be easily tilted in the casing. The outer ring should fit in the housing to a nicety which closely approaches gage work. They can be easily pushed home in such a manner as to permanently upset the soft metal casing, resulting in more noise perhaps from bearings than from the gear teeth. Dismantling and re-assembling gearboxes alone often cures this defective alignment, certain noises disappear but costs are increased. Hole-grinding in gears is not always kept within the limits necessary for good mounting. Bad broaching is common, and combined with inaccurate shaft work runs up fitting costs and often neutralizes good work on gear teeth. An examination of a large number of splined shafts reveals the fact that in many the finish-ground cylindrical surfaces are not concentric. This is largely due to bad centering. Results—bearings do not line with each other and gears run out. Bad workmanship in splined shafts and gear teeth is the rule, not the exception. The limits which should be observed on these details have been given above. The added costs due to the defects mentioned are naturally uncertain, irregular and difficult to assess. They include "running in" and hand-stoning gear teeth, fitting which is wholly unnecessary, dismantling and reassembling, and road testing wholly for gearbox rectification. With many makers road testing for gearbox troubles alone is a formidable item of costs which is wholly chargeable to gearbox production. These costs include wear of tires, fuel, testers' time and general mileage costs, all not infrequently repeated a number of times. Scrap parts are often a large item in costs, and are wholly unnecessary.

Regardless of design, the best running results can only be expected where correct and uniform workman-

*Paper read before the Institution of Automobile Engineers, December 15, 1921.

ship is the rule. With correct workmanship, gearbox assembling should be an unskilled operation, even when the best results are expected. There should be no fitting work whatever. Gears need no stoning or "running in," boxes should not be dismantled and reassembled, special road tests should not be required. Scrap is unnecessary. The designer should be the first to insist on good workmanship, for without it he cannot trace inherent defects, nor try out improvements with any certainty. The engine designer would never have made the progress which he has if he had not been backed by the superior workmanship which is commonly found in the motor car engine. Very few makers would consider for a moment assembling an engine with its principal components made with the indifferent workmanship we usually find in the gearbox. It is doubtful if there is any other working surface in the motor car except the gear tooth which is hardened after it is carefully machined. As with the engine or the axle, the cheapest box is the one which is accurately machined, that is, if the best results are desired. The difference between the costs of irregular and regular machine operations is small, inspection costs may be slightly increased; assembling and fitting costs are the lowest when good machine work can be relied upon.

As to costs of scrap on gears when they are finish-ground, many records show that 1 per cent is ample allowance. The same figure can be taken for splined shafts when they are correctly machined.

Finishing Gear Teeth

The greatest interest naturally centers on the cost of gear-teeth finishing, as this is the most costly of any machine operation in the gearbox. The producer has the choice of various methods. There is not much difference in the costs of ordinary gear-cutting when the best machines are employed in either the generating, hobbing, or plain milling processes. Good, bad and indifferent qualities of work are produced by all methods, much depending on experience and on the methods and supervision employed.

When results are desired which call for gear-tooth treatment after hardening, there is a choice of three methods:

1. "Running in" and stoning.
2. Finishing with a cutter.
3. Grinding with the abrasive wheel.

Grinding with the abrasive wheel gives a quality of tooth form that cannot be produced by any other method; this quality includes theoretical accuracy as well as uniformity, and when the highest quality is required it is the cheapest. When design is suited to production and quantities are possible, gear-tooth grinding adds little, if any, to the cost of the gearbox. Quality for quality, it is the cheapest method that can be employed when total costs are considered. Stoning and "running in" are makeshift processes, irregular in cost and quality. Finishing with a cutter after heat-treatment gives better results than hand-finishing. The greatest additional cost is in maintenance of cutters, which wear rapidly. Strict supervision is necessary to maintain uniformity —only certain grades of hardness can be tolerated. Accuracy of tooth form necessary to very quiet running is impossible.

As a means of reducing costs and assisting to regular output, accurate machining of the splined shaft is second in importance to gear-tooth finishing. There are three forms of shafts for driving gears: the square shaft, the cylindrical shaft, with an inserted key, and the so-called splined shaft. The splined shaft is used in two ways, with the gears mounted on the tops of the keys, and with gears mounted on surfaces between the keys. There is only one method of driving which is recommended as possessing the combined virtues of high quality and low costs. This is found in the splined shaft on which gears are mounted on the circular surfaces between the keys. Mounting gears on the tops of splines or on a square shaft may be considered as a practically impossible method of securing uniform results and one which is consequently costly. The difficulty in both cases is in finishing the inner surfaces of the gear which take the bearing on the shaft. When these surfaces are hardened, costly hand work is necessary to finish them to anything approaching a degree of accuracy. When the gears are mounted on the circular surfaces of the shafts which is between the keys, the hole in the gear can be cheaply ground within fine limits. The splined shaft can also be ground so accurate that no fitting between the two parts is called for, and the gear will run so truly that with good teeth the best possible running qualities are secured. If a box so finished is noisy in running, better workmanship will not cure the evil—design must be studied until inherent defects are corrected and costs due to these defects are eliminated.

Inaccuracies in Gear Teeth

There is one peculiar feature of gearbox costs which is worth special examination, and which is not a regular item of production expenses. It is caused by gearbox troubles which are experienced by many makers. These troubles follow intervals of steady output with those who turn out cars of good quality with fairly quiet running gears Suddenly car after car is turned down by the road inspector and the whole output is held up by gearbox defects. It is a costly business. It is so sudden and disastrous that it might well be termed an epidemic. Investigation often reveals the origin in defective gears, defective in the teeth or mounting. It has been stated that the allowable variation from accuracy in gear teeth is smaller than is usual in the finest grinding work if the best results are desired. The facilities and the experience for keeping gear work within these fine limits exist in but very few workshops. Often large quantities of gears are hardened and completely finished with inaccuracies that can only be detected by a running test. These errors are large enough to cause bad running, but are so small and of such a nature that they are not to be found by ordinary methods of gear inspection. They may be due to the displacement of tooth-form caused by wear in tooth-cutting machines, or in wrongly shaped or wrongly set cutters, or an alteration in the heat-treatment.

It is usually a costly business to face a trouble of this nature. Gears which are hardened after they are finished and are found to be faulty are not easily recovered. Some times the teeth can be ground to correct form so that they run well even with a backlash of 0.025 in. or 0.030 in. If this operation will not save them, they must be added to the scrap heap or badly running boxes must be accepted. If detailed work on gearbox parts is carried out as suggested, spasmodic troubles of the nature described should not occur. Exact costs of gearboxes in which the best running qualities are expected should be capable of being forecasted just as well as in those boxes in which noise is considered of no importance. To avoid unnecessary costs care should always be taken to make certain of the origin of the gearbox troubles. Many times it has nothing to do with the box itself; it sometimes can be traced to defective work in the engine, in couplings or in shafts. When corrections in these parts are made noises in the gearbox disappear.

It may be disappointing that more definite figures as to gearbox costs are not given. They are so difficult to ascertain that exact records are not often kept. As before stated, costs of the original mechanical operations on parts are common knowledge and do not vary to any extent. One thing is certain, the gearbox is more directly responsible for hold-up in output than any other part of the car. This is very costly, and through improved design and workmanship should be eliminated. When it is, exact estimates of costs can be made and relied on. Accurate workmanship is recommended as the indispensable precedent to alteration in design. A complete return of costs should be an indication as to whether the best methods of production are employed or not. Startling revelations await more than one manager who may insist on having a complete return of costs of car production for which the gearbox is directly responsible.

Without doubt, some of the gearbox eccentricities which add to the cost of production are due to heat

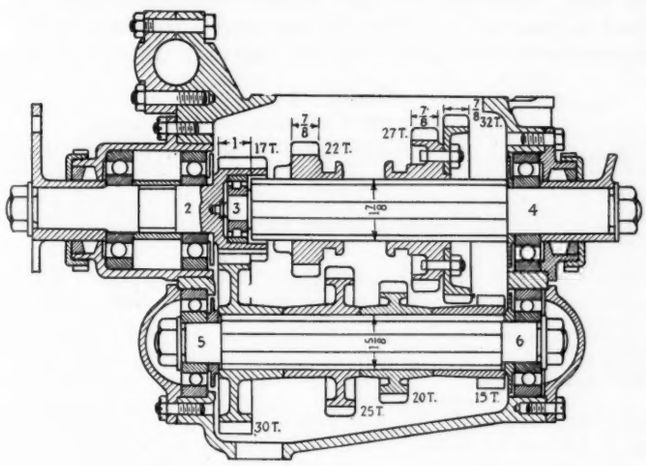


Fig. 5

generated by oil-churning. Thin aluminum casings are easily distorted by heat. Otherwise, the conditions of service which the gearbox has to fulfill are purely mechanical. It should have features of design and specifications of workmanship so that costs could be exactly calculated. Mechanical and assembling operations, clearances, limits, inspections and tests, should be planned as they are for thousands of other mechanisms. In so far as all these details are not definitely dealt with in the course of production, costs will be uncertain. It will, perhaps, be well to repeat the most common workshop irregularities which add to costs:

Most Common Faults

Ball bearings badly mounted in casings.

Spigot ball bearings badly mounted in the constant mesh position.

Inaccurate workmanship on splined shafts.

Gears badly mounted, especially when the gears seat on the tops of keys or on square shafts.

Holes in gears ground with too much clearance and too wide limits.

Holes too roughly finished.

Irregular-shaped gear teeth.

Added to these details is the common lack of correct specifications, of clearances and limits, of good methods of inspection. As to design, costs are increased by corrections which must be made in boxes easily deflected by internal strains and chassis distortions, and by badly designed details. Costs of this nature can only be reduced by the designer himself. There is another detail of design which is often the source of trouble and expense. In both lay shaft and main shaft in many boxes it is possible to lock up the ball bearings so that they are subjected to permanent end strains. It should not be forgotten that in good ball bearings the clearances are only a few ten-thousandths of an inch, and consequently they can be easily unduly strained. If they are so mounted that they must take a load or resist a strain which they are not made to carry, they will give trouble which is costly to locate and to correct. Correcting the errors of workmanship above mentioned and insisting on an inspection by which limits are kept to specification should do more than reduce costs of production. Running qualities would be much improved in all boxes, and a definite line would be drawn between troubles due to workmanship and those to design. These troubles are so often intermingled that they cannot be clearly observed and correct remedies cannot be applied.

When costs of assembling and erecting are low, it may be assumed that fundamentals of design and methods of production are not bad. Some examples of assembling costs will be given for a few boxes, in all of which the quality of workmanship is the best and the running qualities are satisfactory, although the design is more or less conventional.

Time Required for Assembling

Example 1.—A 6-ton truck gearbox with four speeds and reverse. Time of assembling, 6 hr. Time includes all labor for fitting work and assembling of all parts, bearings, shafts, gears, selector and brake parts. This box is never dismantled, but is put into the chassis and never removed. No parts are scrapped. There is no "running in," nor gear-teeth stoning. The running qualities are the best.

Example 2.—A three-speed and reverse gearbox for 15-hp. car. Time of assembling complete, 5 hr. The time includes all labor for assembling and fitting shafts, bearings, gears, change-speed levers, all brake parts, speedometer-drive, cover and housing for universal joint. The box has the best of workmanship throughout and the best running qualities.

Example 3.—A 3-ton truck gearbox with four speeds and reverse. Time of assembling complete, 4 hr. Labor includes assembling all parts of the box except the brake. These boxes were the subject of special inspection for quiet running. In several thousand boxes there was practically no scrap.

The above times given for assembling include the complete cost of the gearbox from the time the machined parts are received from stock until the car is ready to deliver to the customer. They are representative of what should be accomplished on any car of the best quality.

There are records of numbers of cases where changes in limits and new specifications of accuracy were adopted, with the result that dismantling, scrapping and repeated road tests were reduced from a large percentage to practically nothing. Better running qualities were secured and costs reduced.

Suggestions on Design

In Figs. 5 and 6 are shown different designs of gearboxes, Fig. 5 illustrating the weaknesses of a common design of box, Fig. 6 suggesting lines on which an improved box may be evolved.

The power transmitted in both boxes is 35 b.h.p. at 1500 r.p.m. The gear ratios are nearly the same, and the gears selected are 6 D. P., 20 deg. angle of pressure.

The contrasting features of design are principally in

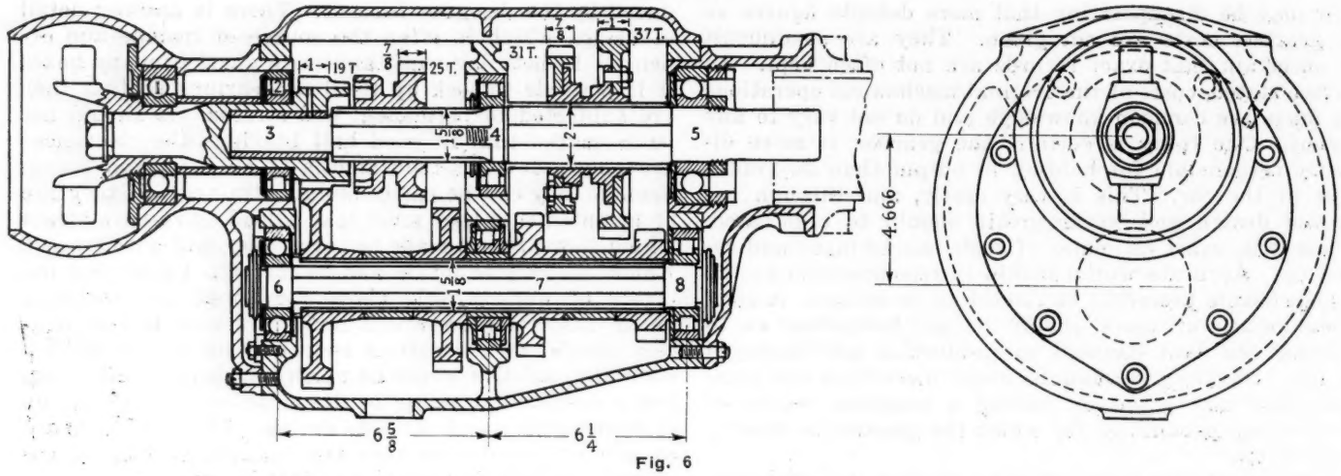


Fig. 6

the method of mounting, the shape and material of the casing, the center distances between the shafts and the distance between the bearings. A special feature of Fig. 6 is the central bearing. It is believed that the circular form of the casing in Fig. 6 will resist stresses better than the box form as in Fig. 5. Two methods of mounting the improved design are shown, the object in both cases being to avoid transmitting chassis distortion to the box itself. In Fig. 6 the ball end to the casing could be set in a socket secured to a cross-member of the frame, the rear end of the casing being secured to the torque tube. The front and rear ends would be malleable castings and the central portion would be of aluminum. With this construction the casing would be well reinforced and further strengthened by a vertical wall in which the central bearings would be housed. In Fig. 6a the box is bolted directly to the engine casing, a practice which is to be noticed in many new designs. It seems to predominate in American and French cars. A few models are now made with the ball joint and torque tube mounting.

The outside dimensions of Fig. 6 are greater than those of Fig. 5. The distances from bearing to bearing in Fig. 6 are 6⅝ in. and 6¼ in. as compared with 10¼ in. in Fig. 5. The center distances are 4.666 in. in Fig. 6 and 3.9166 in Fig. 5, a difference of ¾ in. This increase in center distance is fully as important as the decrease in the lengths of the shafts between the bearings. Larger gears can be used, and there is ample space for housing ball bearings, which are well above their load. Contrasting velocities, loads and stresses are shown in Table I. The velocities of the gears in Fig. 6 are very

Table I

Gear	Gear Velocity, Load and Stress: Pitch Line Velocity, Fig. 6	Pitch Line Velocity, Fig. 5	Tangential Load, Fig. 6	Tangential Load, Fig. 5	Stress, Lb. Per Sq. In., Fig. 6	Stress, Lb. Per Sq. In., Fig. 5
C. M. pinion.....	1,244	1,114	928	1,038	17,750	20,600
Third slider.....	1,040	928	1,105	1,240	22,400	25,800
Second driver.....	840	742	1,370	1,555	27,750	33,300
First driver.....	638	556	1,805	2,070	34,500	49,250

little higher than in Fig. 5; the loads and stresses are very much less. Good construction is difficult when the center-distance between the shafts is small. Sometimes it is so restricted that ball bearings cannot be used with a proper load-capacity, as indicated in Table II. In this table the maximum bearing loads, the revolutions per minute, and the bearings with safe loads as given by the makers, are shown. In the design shown in Fig. 6 it is possible to use ball bearings with safe loads in all cases. In the design in Fig. 5, on account of the close center-distance, it is impossible to use the makers' "safe-load" ball bearings in bearings 2, 4 and 6. Roller bearings with "safe" loads could be used in 2, 4 and 6. In this case, however, an end thrust bearing should be added in bearing 4. Table III has been compiled to show the maximum and safe loads on bearings which are di-

Table II

Maximum Actual Loads and Safe Loads

Bearing Number	Fig. 6: Max. Load, Lb.	Fig. 6: R.P.M. of Bearing	Fig. 6: Safe Load, Lb.	Fig. 5: Max. Load, Lb.	Fig. 5: R.P.M. of Bearing	Fig. 5: Safe Load, Lb.
1	297	1,500	1,540	420	1,500	1,180
2	1,287	1,500	1,500	1,327	1,500	1,180
Spigot						
3	262	....	....	862	532	*1,220
4	1,202	620	1,880	1,925	400	1,870
5	1,505	396	2,500	810	850	1,320
6	803	770	1,490	1,870	850	1,320
7	1,030	770	1,890			
8	1,575	770	2,930			

*If a ball bearing is fitted here, as is often the case, it would have a safe load of 620 lb.

rectly comparable in Figs. 6 and 5. The pilot bearing in Fig. 5 design is shown with rollers. It is often a ball bearing too small to carry the load. Results which are of special interest seem to be brought about by the introduction of a central bearing, as in Fig. 6. Table IV has been compiled to show the effect of this bearing in the distribution and minimizing of loads. The maximum bearing load in Fig. 6 is 1575 lb.; in Fig. 5, 1925 lb. The minimum load in Fig. 6 is 0; in Fig. 5, 275 lb. It is instructive to contrast loads on individual bearings.

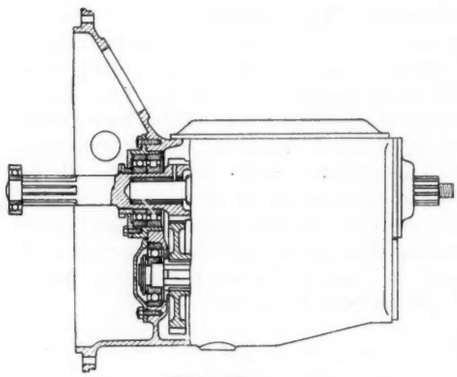


Fig. 6A

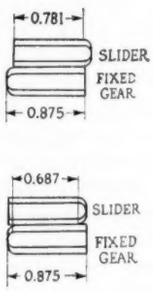


Fig. 7

Table III

Maximum Actual and Safe Loads on Like Bearings in Lbs.

Bearing Number	Fig. 6: Max. Load	Fig. 6: Safe Load	Bearing Number	Fig. 5: Max. Load	Fig. 5: Safe Load
1	297	1,540	1	420	1,180
2	1,287	1,500	2	1,327	1,180
3	262	....	3	862	1,220
5	1,505	2,500	4	1,925	1,870
6	803	1,490	5	810	1,320
8	1,575	2,930	6	1,870	1,320

The pilot bearing is an inherent weakness of the standard gearbox. With the central bearing this weakness is partly neutralized. The overhung ball race in Fig. 5 supporting the pilot end of the main shaft should be contrasted with the plain pilot bearing in Fig. 6, which is seated well inside the constant-mesh pinion. In Fig. 6 this bearing on the first speed and second speed takes no load; in the third speed it takes 262 lb. contrasted with first, second and third speeds in Fig. 5 of 275 lb., 758 lb. and 862 lb. respectively. Bearing No. 6, in Fig. 5, is a bearing which in nearly all four-speed boxes takes the heaviest load when the first-speed gears are engaged. In the box of one well-known car two ball bearings are used in this position. The contrast is, in Fig. 6 (bearing 8), 1575 lb., in Fig. 5 (bearing 6), 1870 lb.; in Fig.

TABLE IV

	Loads in Lb.					
	First Speed		Second Speed		Third Speed	
Bearing No.	Fig. 6	Fig. 5	Fig. 6	Fig. 5	Fig. 6	Fig. 5
1	297	420	297	335	297	340
2	1,287	1,327	1,287	1,045	1,100	1,045
Pilot						
3	0	275	0	758	262	862
4	415	1,925	1,202	897	918	458
5	1,505	810	258	635	0	630
6	803	1,870	803	900	650	480
7	230		1,030		820	
8	1,575		292		0	

5 (bearing 4), on first speed the load is 1925 lb., compared with Fig. 6 (bearing 5) on first speed, 1505 lb. There are several instances where the loads on bearings in Fig. 6 are heavier than on the same bearing in Fig. 5. As pointed out, the increased center-distance in Fig. 6 allows the use of bearings with plenty of surplus capacity. In Table V tooth pressures are contrasted. The difference in favor of gears in Fig. 6 is due to the widths of the gears and to sliding the gears so that the full possible working tooth contact is made use of. This is often overlooked in the standard type of gearbox. Fig. 7 shows the method of overlapping suggested, which increases the length of the box by ⅜ in.

The gears in Fig. 6 are reduced in variety as far as possible. The gear teeth numbers are duplicated; there are two 19-teeth, two 25-teeth, two 31-teeth and two 37-teeth gears. The variety of teeth in the gears in Fig. 5 is quite common, and is an unnecessary addition to costs and trouble in gear-tooth finishing. The gears in Fig. 6 are in all cases designed to facilitate the cheapest production on the most costly operation, that is, tooth-finishing. Some of the gear teeth can be finish-ground, four at one setting. The sliding gears in Fig. 6 have a much better seating on the main shaft than the sliding gears in Fig. 5; the space between the fixed gears is, however, greater in Fig. 6 than in Fig. 5, but shaft deflection is prevented by the central bearing. That portion of the main shaft on which the second and first-speed gears slide, is made larger in Fig. 6, principally to facilitate assembling. The particular design of the first, second and third-speed sliders is suggested in Fig. 6, so that these gears, when under load, will be close to the supporting bearings. As the gears taking the heaviest loads, the first speeds in Fig. 6 are made with a wider face than the third and second-speed gears.

Recommended methods of locking up bearings are shown in Fig. 6. They are so locked that the end thrusts are taken on the ball bearings Nos. 1, 5 and 6. The other bearings are rollers and have a free end movement. With this construction it is impossible to throw loads on to the ball bearings which they are not made to carry. It hardly needs to be mentioned that with the central bearings all gears are well supported when under load, much better, indeed, than they would be with abnormally large splined shafts with no central bearing. Production costs of a box made on the lines suggested in Fig. 6 should be but little in excess of those of a box as in Fig. 5. The number of parts is increased by two central bearings, and the end pieces to the casing are more expensive. Weight will be somewhat increased, but this is essential to substantial mounting for highly stressed gearing. For many years the endeavor has been made to get good results from the conventional design—it has failed. The motor car maker must decide whether he will carry on with the old type or not. No box is known in which are embodied all the principles shown in Fig. 6, though each separate detail is to be found in different boxes. To get the best results they should be combined. To do this and not increase weight over that of the usual design is impossible. As previously stated, stability and rigidity must be the guiding principles of gearbox design. These principles cannot be adhered to if flimsy construction is permitted. With correct methods of manufacturing, total costs of production of an improved design need not exceed those now paid when the endeavor is made to supply a good running box of inferior design.

TABLE V

	Tooth Pressure per Inch of Contact					
	Total Face, In.		Actual Contact, In.		Lb. per In. of Contact	
Gear	Fig. 6 In.	Fig. 5 In.	Fig. 6 In.	Fig. 5 In.	Fig. 6	Fig. 5
C. Mesh	1.0	1.0	1.0	1.0	990	1,100
Third Speed	0.875	0.875	0.781	0.687	1,510	1,920
Second Speed	0.875	0.875	0.781	0.687	1,870	2,410
First Speed	1.0	0.875	0.8125	0.687	2,360	3,200

Fig. 6 is intended to illustrate as far as possible the principles which must be followed in gearbox design if quiet running is desired. No claim can be made that a box exactly as shown will be the ideal box. As before stated, such a box cannot be produced without individual experimental and development work. Design will vary, of course, to meet the service called for by the car in which it is mounted.

Simplified Theory of the Magneto

THE Bureau of Standards has recently made some experiments on ignition for the National Advisory Committee for Aeronautics. Part of the results of these investigations have been published in a paper known as Report No. 123.

This paper describes a type of circuit which has been found useful for representing the action of the high-tension magneto. While this equivalent circuit is relatively simple, and consequently can be used as a basis for deriving definite mathematical formulas for induced voltages and similar quantities, it has been found experimentally to correspond quite closely in its performance with the highly complicated electrical circuits of an actual magneto. In the paper, formulas are given for the voltage induced in the secondary under various conditions of operation, and a number of numerical examples are worked out, showing the application of the equations to a variety of practical problems.

A copy of Report No. 123 may be obtained from National Advisory Committee for Aeronautics, Washington.

The "All-Purpose" Tractor on the Modern Farm

Farmers must have machines designed to perform a multiple of tasks, not those for one or two uses. This writer is of the opinion that unless a change to this effect is brought about the industry will go backward.

By J. S. Clapper*

I KNOW I am subjecting myself to criticism by some of the tractor men in going on record by saying that unless some changes are made by the manufacturers, and that very quickly, the tractor business has reached its peak and it will be a long time before the farmer can be persuaded to accept the present type of machine and to do his part in motorizing his farm.

There is too big a gap between what the manufacturer receives for his product and what the farmer has to pay. The manufacturer does not get enough money to later meet all the demands made by the selling organization and the user. I am of the opinion that the tractor industry has reached the most critical period in its history and, whether it goes forward or goes backward, depends entirely upon the manufacturer and the sales organization through which all products must find an outlet.

That the tractor business is sick, we must all admit, but, how many of the manufacturers have made the proper remedy, I do not know. But I do know that some of the large manufacturers of accessories, necessary to the production of tractors, as well as the managers of some of the most prominent advertising mediums are fully awake to the situation and are trying to place some of the actual facts before the manufacturer. We all know that it takes more courage to correct a mistake than to suffer with it for years.

From my observation I am thoroughly convinced that the farmers have been quicker to appreciate the possibilities of applying mechanical power to their farm operations than the manufacturer and I base this statement on the fact that the manufacturers as a whole have held to a "one-purpose" machine, expecting the farmer to arrange his work to fit the machines instead of analyzing the farmer's conditions and supplying him with a machine that will fit the work to be done on his farm. I think this comes more from following the old custom of designing and perfecting a machine or implement to do one certain class of work.

In the development of the tractor in the early days there were only two operations considered by the manufacturer: first, the breaking out of the large acreage of prairie sod and, second, the pulling of separators for threshing or belt power. I often wonder if the manufacturer of farm implements has ever given the farmer the credit he is entitled to for the part he has played in developing and perfecting every farm implement that has been put on the market. It was the farmer who first discovered he could pull disk-harrows and a battery of seeders and hook up the binders for cutting grain with his tractor.

No one who has any knowledge of farming with horses, in the strictly grain section, and has seen them replaced by a well designed tractor can question its adaptability and the wonderful saving over horses, and it was in this field that the present type of tractors have been developed and found such a ready market but this field is small as compared to the entire acreage cultivated; besides, I'm wondering if the demand has not already been supplied.

A tractor designed to meet all the conditions and requirements in the diversified farming sections will find five prospective purchasers where there is one for the "one-purpose" machine. It is only necessary to consult the government figures, that show the annual acreage devoted to row crops every year in the different states which must be cultivated from three to five times each season, to convince anyone of the possible demand for the all-purpose power plant on the farm.

I believe the government report further shows that there is a total annual loss of $232,644,000 because of weeds in corn, cotton, potatoes, beans, sugar beets, sweet potatoes and soy beans from the lack of proper cultivation, and it has been my firm conviction for several years that with the experience we have all gone through, it was entirely practical and feasible for the engineers and manufacturers to correctly analyze the farmer's requirements and hold their design and actual accomplishments to fit the work to be done.

The most difficult operation in farming is the first and second cultivation of the tender plants and, unless the operator has an entirely unobstructed view of the rows and the machine has the necessary flexibility so that the cultivating teeth or the shovels will respond promptly to every move of the operator, good clean cultivation is not possible without injury to the plants. Unless we can give the farmer a machine capable of doing equally as good cultivating, easier and more economical to operate and which will perform the work faster with less effort on his part than can be done with horses, we have little argument to persuade him that he should motorize his farm.

What argument can a salesman put up to the farmer today to persuade him to invest twelve to twenty-five hundred dollars in a machine with the present price of horses and feed when the records show tractors have replaced only 20 per cent to 22 per cent of the horses. What would be the result if another salesman could show this same farmer a machine so adaptable to his work that it would actually replace 75 to 80 per cent of his horses and 40 to 60 per cent of his surplus labor and the price was within his reach.

The machines must be readily adapted to the different classes of work and at a price within the farmer's purchasing power, which has now reached the lowest point in our history.

The "all-purpose" machine or a machine so designed

*President of the Toro Motor Company, Minneapolis. Condensed from a paper read before the Minneapolis Section of the S. A. E.

that it can be easily adapted to more different kinds of work on the farm is entirely practical and will be readily accepted by the farmer who is looking for more improved and economical methods. I do not want to be classed as a pessimist as there is no one engaged in the tractor business more optimistic over the possibilities of power farming or the success of motorizing the farm than I. We must motorize our ideas and our own products before we can expect the farmer to motorize his farm.

On January 1, 1920, the Agricultural Department at Washington reported a total of 246,000 tractors on the farms in the United States or about one farm out of every 28. The states showing the highest percentage of all farms, reporting tractors in 1920 were as follows:

South Dakota	16%
North Dakota	15%
Montana	12%
California	10%
Kansas	10%
Illinois	9%
Iowa	9%

The complete report released by the department covering the year 1920 gives the total valuation of all farm equipment manufactured in the year 1920 at $537,000,000. The report further shows there were manufactured in 1920, 203,000 tractors, the value $193,000,000 or more than one-third of the total of farm equipment. It is estimated there were about 160,000 of these tractors marketed during the year.

Now, let us take the acreage of the four principal crops for ten years. The report shows as follows: In 1910 there were 69,000,000 acres of corn; in 1919 63,000,000 of corn or 3,000,000 less than in the year of 1910.

In 1910 there were 32,000,000 acres of wheat; in 1919 53,000,000 or an increase of 11,000,000 acres.

In 1910 there were 27,000,000 acres of oats; in 1919 31,000,000, an increase of 6,000,000.

In 1919 there were 14,000,000 acres of cotton; in 1919 15,000,000 acres, or an increase of 1,000,000 acres.

These figures would indicate there has not been a very great increase in the acreage of the four principal crops during this period but the figures show that the value of farm implement equipment during that period has increased 185 per cent.

It has been the custom of the Agricultural Department to tabulate each season the totals of 22 of the principal crops, one-half of which are row crops requiring cultivation. The following figures are given by states, indicating the difference in valuation of these 22 crops produced in 1919 and 1920:

New York.—Of the 22 crops, there was a drop of $23,000,000; of the total crop, a drop of $32,000,000;

Pennsylvania.—Of the 22 crops, there was a drop of $50,000,000; of the total crop, a drop of $77,000,000;

Maryland.—Of the 22 crops, there was a drop of $18,000,000; of the total crop a drop of $23,000,000;

New Jersey.—Of the 22 crops there was a drop of $3,000,000; of the total crop, a drop of $6,000,000;

Ohio.—Of the 22 crops there was a drop of $173,000,000; of the total crop, a drop of $199,000,000;

Illinois.—Of the 22 crops there was a drop of $344,000,000; of the total crop, a drop of nearly $400,000,000;

Iowa.—Of the 22 crops there was a drop of $263,000,000; of the total crop, a drop of $450,000,000; and

Minnesota.—Of the 22 crops, there was a drop of $197,000,000; of the total crop, a drop of $212,000,000.

It will be noted that the loss in the middle and western states is considerably greater than in the New England states. This is an indication of the shrinkage in the valuation the farmer has taken in the last 12 months.

As regards the machines produced the following figures show the number of manufacturers and sizes of machines made in 1920.

Horsepower	No. of Manufacturers	No. of Machines
8 hp. and less	6	7,678
9-15	8	3,366
16-18	17	107,782
19-22	17	39,964
23-26	24	18,073
27-32	33	12,861
33-39	10	1,410
40-59	15	3,684
60 and over	13	1,389
Total		203,207

Value: Of this total number manufactured, only about 29,000 were estimated sold for export, leaving 175,000 for domestic trade. The total of all farm equipment manufactured during 1920, amounting to $537,000,000, only $66,000,000 was estimated sold for foreign trade, leaving $471,000,000 for our domestic trade.

THE farmers have been quicker to appreciate the possibility of applying mechanical power to their farm operations than the manufacturer. This statement is based on the fact that the manufacturers as a whole have held to the "one purpose" machine, expecting the farmer to arrange his work to fit the machine instead of analyzing the farmer's conditions and supplying a machine that will fit the work to be done on his farm.

It must be remembered our export on all lines of farm equipment declined during the war while production was normal except in 1918 and our surplus, formerly going to Europe, was accumulating here. Then with our enormous increase in production during 1919 and 1920, caused by the urgent appeal of the Government officials, is it not only reasonable to assume we would have felt the effects of over-production in the farm equipment line even though the farmer's product had held up in prices. If you will consult the records as far back as you please, you will find this one thing: Whenever our imports go up and our exports come down so that the imports exceed in value our exports, we feel the effect in all lines of business and not until our surplus begins to move to foreign countries, does business improve to any marked degree.

A great deal has been said and written about selling the country banker on farm tractors. Few really consider the matter from the banker's standpoint. The banks are not in position to extend further accommodations to the farmer until he has liquidated some of his present debts.

A majority of the farmers, who want to buy a gas tractor on time, want the banker to go back of the deal and take the gas tractor as security. We all know that after the machine has been used for one or two years, and put up for sale under foreclosure at the end of the season, it brings a very small part of the purchase price. Besides the banker must judge at the outset whether in his opinion the tractor is going to be a profitable investment for the farmer, especially if he is furnishing the money. If he does not think it will prove a profitable investment, and the farmer has no other resources behind him to take care of the obligations when they come due he naturally refuses to lend the money.

I believe the country banker has been criticized too severely for not financing the farmer in tractor sales.

Fifth Semi-Annual Gasoline Survey

Bureau of Mines reports results of investigation into price and physical characteristics of fuel sold in various localities throughout the country. There has been but little change in quality during the past year, but the price, normally lower in winter, is higher than last summer.

IN order to obtain information concerning changes in the character of motor gasoline, the Bureau of Mines two years ago began a series of semi-annual surveys. The fifth of these, covering gasolines marketed in January, 1922, has just been completed.

The July, 1921, survey showed that the average motor fuel sold at that time had a surprisingly high volatility. This was contrary to expectations, because for a number of years past "summer quality" gasoline has been much less volatile than "winter quality." Gasoline stocks were largely drawn upon during the summer and the country entered the winter period with little more gasoline in storage than is normal.

The present survey shows that the quality of the gasoline being sold during the present winter is, on the whole, similar to that sold a year ago. This indicates that the condition of high volatility reported last summer was only temporary and that there has been no radical change in the refining or marketing methods employed.

Present tank wagon prices are practically the same as last summer. The following table gives some comparative tank wagon prices (in cents per gal.) in the cities indicated:

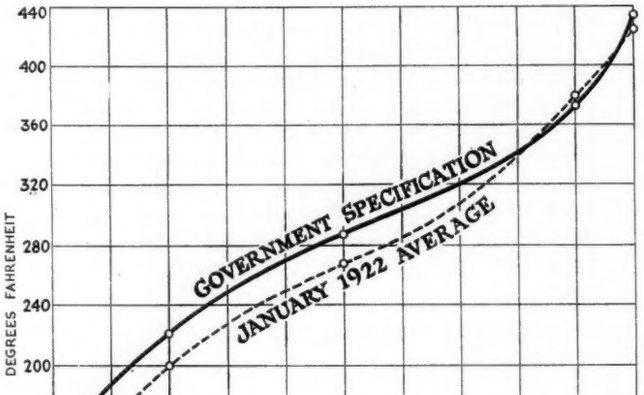


Chart showing how the average distillation curve of gasoline sold throughout the country compares with Government specifications for this fuel

	July, 1921	Jan. 1922	
New York City	24.0	25.0	+1
Washington	22.0	22.0	Same
Pittsburgh, Pa.	22.0	23.0	+1
Chicago, Ill.	18.0	19.5	+1.5
New Orleans, La.	17.5	21.5	+4
St. Louis, Mo.	17.4	18.9	+1.5
Denver, Col.	22.0	21.0	—1
Salt Lake City, Utah	25.0	25.5	+0.5
San Francisco, Cal	23.0	21.0	—2
Average	21.2	21.9	+0.7

The bureau's first gasoline survey was made in 1915, a second in 1917 and a third in April, 1919. Two limited surveys were made in 1920. All of these showed a continuous decrease in the volatility of gasoline, probably due to an increase in demand. By January, 1921, however, the volatility had increased to some extent and since that time there has been little change in the gasoline marketed.

Although the general average for the entire country shows very little change from last year, differences are noted when individual cities are compared. A decided improvement is observed in the gasoline sold in Salt Lake City, the initial boiling point decreasing 13 deg. F., the end point decreasing 27 deg. F. and the average boiling point decreasing 24 deg. F. Gasoline sold in Washington, D. C., also showing an improvement, initial boiling point being lowered 20 deg. F.

In this survey 119 samples of gasoline were collected from nine cities, the samples being taken as in previous surveys. The analyses were made in accordance with the methods given in Technical Paper 214 of the Bureau of Mines, entitled "Motor Gasoline," by E. W. Dean. The actual specific gravity at 60 deg. F., corresponding Baumé gravity, initial boiling point or "first drop," 20, 50 and 90 per cent points, end point and average boiling point, and the percentage recovered in the receiver were determined for each sample and tabulated. The average figures for each city, as obtained from this tabulation, are collected for purposes of comparison in the table below, which also includes the average for the nine cities, and an average for the eight cities included in the January, 1921, survey.

Average Results of Motor Gasoline Survey, January, 1922

District	Specific Gravity	Baume Deg.	First Drop	20%	50%	90%	End Pt.	Avg. B.P.	Per Cent Recovered
New York City	0.742	58.6	109	205	268	368	421	268	96.1
Washington, D. C.	0.751	56.6	98	195	259	380	428	264	95.8
Pittsburgh, Pa.	0.733	61.3	93	176	256	390	430	260	94.0
Chicago, Ill.	0.751	56.6	104	208	272	386	442	270	96.4
New Orleans, La.	0.744	58.3	114	212	274	371	428	273	97.3
St. Louis, Mo.	0.743	58.5	96	205	279	386	435	274	95.5
Denver, Col.	0.746	57.8	104	201	266	378	432	268	97.0
Salt Lake City, Utah	0.744	58.2	99	197	261	362	412	261	96.6
San Francisco, Cal.	0.762	53.6	112	208	261	359	421	264	97.2
Average for 9 cities	0.745	58.0	102	200	267	377	430	268	96.0
Average for 8 cities included in January, 1921, survey	0.745	58.0	102	199	266	377	430	267	95.9

Tables were also prepared comparing the averages of each city with those of January, 1921, and with July, 1921.

A distillation curve of the average figures for January, 1922, was prepared as well as the curve for Federal Specification gasoline. Distillation curves for the average figures of January and July, 1921, would be practically identical with that of January, 1922, which is given above.

Authorities Show Need for More Efficient Use of Petroleum

One presents in perspective the economic facts relating to petroleum and interprets these facts in their relation to the oil and allied industries. The other authority deals with the utilization of liquid fuels and his book serves to give the engineer a clearer picture of the combustion process.

By Herbert Chase

"WHETHER the output of petroleum in the United States has actually or almost reached its maximum rate is immaterial. Likewise, the exact size of the unmined reserve is of secondary importance. The point to be emphasized is the coming necessity for increasing the overall efficiency of petroleum—a problem that concerns not only the producers and refiners of oil but the manufacturer of appliances that consume its products as well. From now on the tendency will be to use relatively less of the material itself, but to put greater effort into increasing the service value extracted from it." Such is the statement contained in the preface to a book entitled "The Economics of Petroleum," by Joseph E. Pogue (John Wiley & Son), one of the two best books dealing with various aspects of the liquid fuel situation which have come to our notice within the past year. Standing alone, such a statement would call for relatively little notice, but when made as a result of perhaps the most thorough and comprehensive study of the economics of petroleum ever made, it is worthy of careful consideration. This, indeed, may be said of the book as a whole. The data used are of the most authoritative character and are presented with unusual care and in excellent graphical form. Present trends are projected into the immediate future in cases in which the author considers this feasible from the data in hand.

Fuel Consumption

When the people of one representative State, Ohio, spend from $80,000,000 to $100,000,000 annually on fuel for automotive vehicles, the Experiment Station of their State University need offer no apology for compiling a bulletin in which the economical use of this fuel is discussed at some length. Just this has been done by Prof. C. A. Norman on behalf of the Experiment Station of Ohio State University, and the 200-page book, entitled "The Economical Utilization of Liquid Fuel," which has resulted (it is known as Bulletin No. 19 of the Engineering Experiment Station), is a credit both to the university and the author. Professor Norman, in concluding his book, expresses the hope that adherence to the existing type of throttling carbureting engines will not prevent courageous and broad-gage engineering development in the prime-mover field. He sees great prospects for the injection type of engine for automotive use, but does not reach his conclusions without making a thorough analysis of the advantages and disadvantages of the conventional and various other types.

The opening chapter of Doctor Pogue's book outlines the economic organization of the petroleum industry, and the second deals with the resource situation. Maps and charts showing the distribution of the important oil pools of this country and the world and their relative importance are given. Successive chapters deal with the trend of oil-field development and oil production, the transportation of crude, refinery practice, capacity and outlook. Chapters IX and X, which deal with gasoline and kerosene, should be of special interest to the automotive industry, since its products are by far the largest users of gasoline and also consume large quantities of kerosene. The characteristics and source of straight-run, natural-gas gasoline and cracked gasoline are briefly discussed, and interesting charts, which show how the endpoint has increased and to what extent the total supply has been affected by this increase and by other factors, such as cracking and the use of casinghead, are given. Other charts and the accompanying text cover the various factors affecting demand and show how the demand is divided between various classes of automotive equipment.

Status of Kerosene

The present status of kerosene and the various factors of supply and demand are discussed in similar fashion. It is pointed out that the future requirements for motor fuel loom so large that it is questionable whether it will not ultimately cease to be marketed in any large quantity. The chapter on fuel oil is of less direct interest to the automotive industry, but shows that the future demand for this fuel will probably come largely from automotive sources, as a result of the probable conversion of fuel oil into automotive fuel, on the one hand, and from shipping on the other.

"Lubricating Oils" is the title of Chapter XII, which deals with a subject of prime importance to the automotive industry. Various classes of lubricating oils are discussed and the demand and supply analyzed. It is shown that the demand for automotive lubricants accounts for about a quarter of the nation's output, and that this demand has placed a high premium upon the heavy-bodied cylinder stocks which have consequently risen rapidly in price and are more and more difficult to secure in adequate quantities. This situation has been further aggravated by the tendency toward fuel dilution of lubricants which has accompanied the use of fuels with higher endpoint.

Succeeding chapters deal with petroleum by-products, natural gas and gasoline derived from it, marketing, export and price of petroleum products, relation between price and production of crude, the bearing of automotive transportation upon the oil industry, and the economic

significance of cracking. Chapters XXI and XXII, dealing with composite motor fuels and the motor-fuel problem, contain but little that is new to readers of AUTOMOTIVE INDUSTRIES, but include concise statements on these subjects which can be read with profit even by those who know the fuel situation in its broader aspects, and should prove illuminating to both automotive engineers and executives whose close consideration of immediate problems in their own routine work often find them without a broader knowledge of the fuel situation, which is, after all, of paramount importance.

The concluding chapters of Pogue's book deal with the city-gas problem, international aspects of petroleum, Mexico as a source of petroleum, the relation of the coal industry to the oil industry, oil shale, full utilization of petroleum and the function of statistics in the petroleum industry—subjects which have a more important bearing upon the automotive industry than a mere reading of the chapter titles can possibly indicate. Treatment of these subjects rounds out the author's consideration of the economics of petroleum in most satisfactory fashion, and leave one with a feeling that time spent in reading this book is well spent, as it is for all who appreciate or desire a thorough understanding of the important part which petroleum plays in our modern civilization.

The Economical Utilization of Liquid Fuel

A grasp of the general economic situation in respect to petroleum is a valuable asset, but it is quite as, or perhaps more, important for engineers to understand how fuel energy can be used to best advantage in the development of power, and it is with this in mind, among other objects, that Professor Norman has written the bulletin referred to above. This bulletin is divided into three parts, the first dealing with the oil fuel situation, the second with fuel utilization in combustion engines, and the third with a scientific discussion of combustion engine processes. Articles 1 and 2 of Part I treat briefly of the resources and consumption of petroleum and the forms of oil and their uses, and Article 3 with petroleum substitutes. Much of this information is similar to that under corresponding heads in Pogue's book, but is necessarily much more condensed, and in some instances not quite so nearly up to date as that presented by Pogue, though considerable material useful to the engineer and not given by Pogue is included. Particulars regarding certain physical and chemical characteristics of various grades of gasoline, benzol and alcohol, including the distillation curves of these fuels in their commercial form, are given.

The author quite properly draws attention to the poor average efficiency of automobile engines, especially under prevailing part load conditions, and sees much promise in the development of the injection type of engine, which is more efficient, especially under light loads, than the conventional type.

In Part II the nature of fuel, of combustion and of the heat value of fuel is explained, and the heat values and air requirements for a number of fuels are given. The function of expansion in converting combustion heat into power is then considered, and the necessity for early completion of the combustion and of maximum possible expansion for good fuel utilization is stressed. It is emphasized that compression is of importance to fuel economy only by enabling expansion, and it is pointed out that the fuel economy of Diesel engines is better at reduced load than at full load because the expansion at reduced load is greater than at full load. The variation in mixture requirements of present-day carbureting engines for best economy is discussed.

The evil effects of the burnt residue on the fuel economy of throttling carbureting engines at reduced load is pointed out and various means proposed for overcoming these effects are referred to. The progress of combustion is considered; likewise the nature of knock and the methods of overcoming knock. The difficulties resulting from poor evaporation and distribution of the fuel are taken up and various methods of fuel conversion and charge heating are scrutinized. The influence of friction losses on economy at reduced loads forms the subject of one article; the influence of vehicle speed and gear ratio, that of another.

Comparison of Prime Movers

Steam engines and injection engines can run on fuels heavier than those which a carbureting engine can utilize. Both these classes of engines show better maintenance of economy at reduced load than does the present-day carbureting engine. The possibilities of these two types of prime movers for automotive purposes are discussed and the strong points of each are pointed out.

While Part II contains considerable material that will not be new to those who are familiar with elementary thermodynamics and other related information upon which engine design is based and, while much material already published in papers read before the Society of Automotive Engineers and elsewhere is quoted, the chapter is well worth study and can be read with profit even by those well acquainted with these subjects. It contains, furthermore, some tabular and other data useful for reference purposes.

Part III, as its title indicates, is largely a scientific and somewhat theoretical though none the less useful consideration of the combustion engine process. The treatment of the subject is primarily of interest to students of thermodynamics, but is so presented as to be readily used by most engineers who are apt to have the inclination to apply it, as they may well do in their analysis of problems to which it refers. The author has made an effort to present the material as clearly as possible and in very usable fashion. The data on dissociation and on specified heat of combustion gases at various temperatures is of great value, as is also the entropy chart which the author and his associates have worked out with no little labor and, the author believes, for the first time in American units. It is of great value in the study and understanding of combustion phenomena, and is a credit to those concerned in its preparation. By its use it is possible to closely predict the probable efficiency of various types of internal combustion engines, including gas turbines.

Germany to Resume Aircraft Manufacture

NO aircraft has been manufactured in Germany since the acceptance of the Treaty of Versailles. Production of aircraft in that country was prohibited for a certain period by the peace treaty, and this period was later extended as a penalty for the destruction by the Germans of a number of Zeppelins which, according to the peace terms, were to be delivered to the Allies. This prohibition period expires on May 5 next, at which time the Allied Air Control Commission, under the direction of the British Air General Masterman, will discontinue its activities.

While the aircraft industry in Germany has been dormant for the past four years, it was kept alive by the Government, which recognized in it a great national asset. Now that the Germans can resume the manufacture of commercial airplanes without restrictions, it is expected that the business will develop rapidly.

Economics of Highway Transport

This outline shows the scope of the highway transport field and the study necessary for development. Economic phases of highway transportation are discussed and illustrated by means of a Topical Outline Chart.

A TOPICAL outline of data to be developed concerning the economics of highway transport has recently been issued by the Highway and Highway Transport Education Committee. This outline, while tentative in nature, indicates clearly the scope of the highway transport field and the studies necessary in its ultimate development. While issued primarily for the aid of teachers and students, this outline is of definite interest to manufacturers, since the automotive industry is basically interested in the development of the educational work involved.

This preliminary topical outline of the economics of highway transport was prepared by Lewis W. McIntyre, assistant professor of civil engineering, University of Pittsburgh. It is designed to stimulate interest in the economic phases of highway transportation and to aid the experiments being carried on by experts in various parts of the country, to whom officers and taxpayers alike may turn for the fundamental data without which developments of this character cannot be intelligently planned.

The report presenting the outline states that "the outline makes no pretense of being either complete or adequate." It has been limited in various ways. The newness of the subject and the consequent lack of authoritative research make definite conclusions and principles impossible.

Some of the topics are capable of considerable expansion; their use will be determined by the local situation. Others may be used almost as outlined. It is confidently expected that use of the outline will develop innumerable suggestions for its revision. Such suggestions and constructive criticisms will, we are informed, be greatly appreciated.

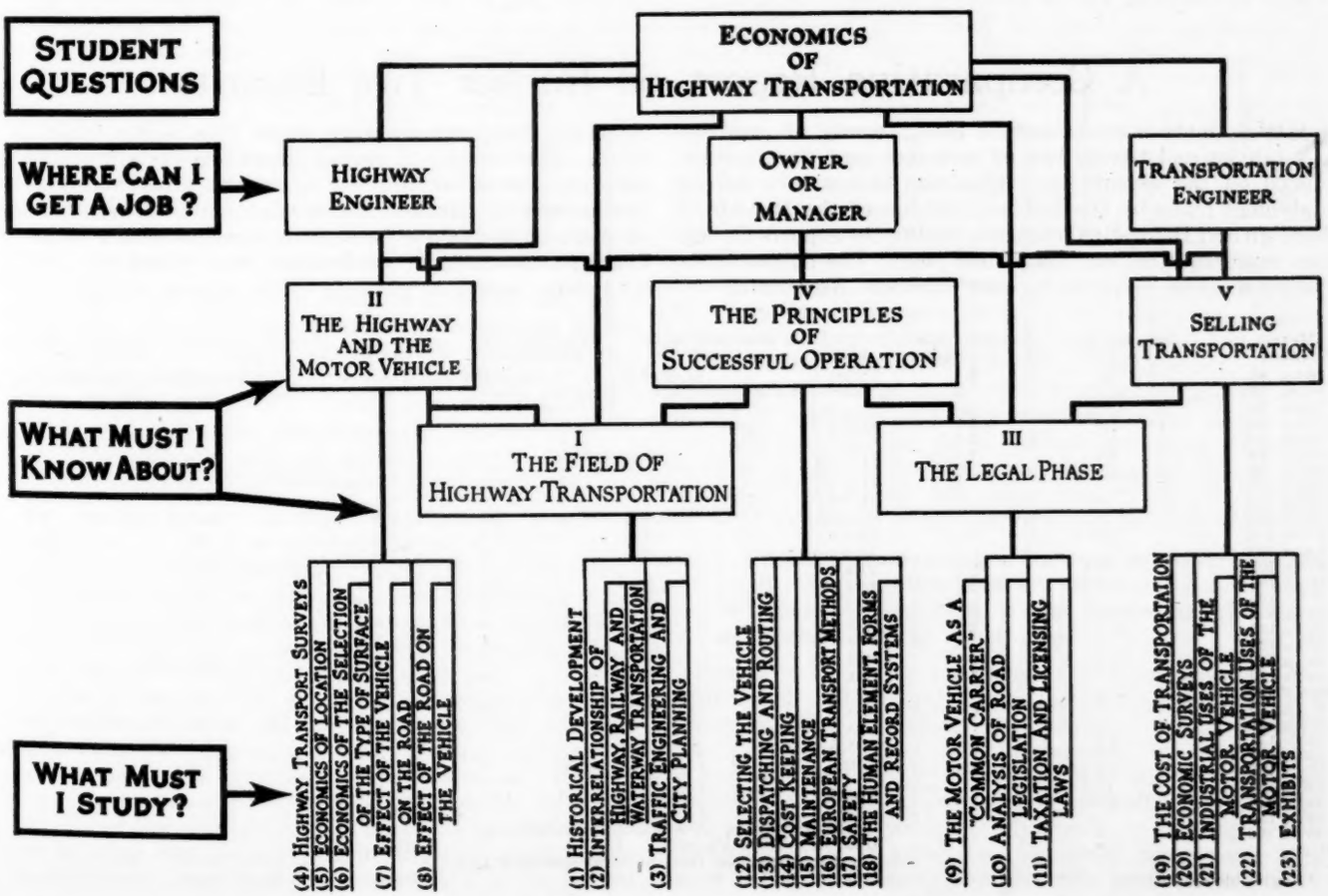
The outline is as follows:

I—The Field of Highway Transport

(1) Historical Development.—Steps in the development; relation of transportation to civilization; problems awaiting solution; magnitude of the problems; the highway program; the field for trained men; salaries available; probable future development.

(2) Interrelationship of Highway, Railway and Waterway Transportation.—Correlation of all forms of service; the electric railway and highway transport; the steam railway and highway transport; the waterway and highway transport.

(3) Traffic Engineering and City Planning.—Relation of



transportation problems to city planning; historical development of city transportation; street traffic problems; street railway problems; traffic regulation.

II—The Highway and the Motor Vehicle

(4) Highway Transportation Surveys.—The traffic census, its purpose, use and limitations; economic survey of transportation; needs of local industries; use of vehicle registration data; intangibles; capacity; peak loads, etc.

(5) Economics of Location.—General considerations; minor details of alignment, distance, curvature, rise and fall and their effect on the cost of transportation; ruling gradient and curvature; typical calculations of effect of these items on operating expenses; justifiable expenditure for their reduction; virtual profile.

(6) Economics of the Selection of Type of Surface.—Adaptation of motor vehicle and highway to one another; limiting factors; economical traffic unit; typical calculation of economical traffic unit; other factors affecting type of construction; economical life.

(7) Effect of the Vehicle on the Road.—Type of vehicle; horse-drawn, high-speed, rubber-tired motor truck stresses induced; types of failure; effect of weight; effect of speed; impact; experimental investigations; types of roads, rigid and non-rigid; traffic intensity; unsprung weight; pneumatic tires.

(8) The Effect of the Road on the Vehicle.—Stresses in motor vehicle; stresses due to load; twisting strains caused by road irregularities, shocks caused by rough roads; driving shocks and loads; braking shocks and loads.

III—The Legal Phase

(9) The Motor Vehicle as a Common Carrier.—The Trend of existing legislation; operation on regular routes; hauling for selected patrons; passenger service; freight service; effect of regulation; result of non-regulation; arguments pro and con; constitution of the regulating body.

(10) Analysis of Road Legislation.—Development of the theory of road laws; analysis of existing laws; effect on transportation; possible changes.

(11) Taxation and Licensing Laws.—Methods of taxation, gasoline tax, tonnage tax, tax according to use, etc.; weaknesses of present systems; outlook for the future.

IV—The Principles of Successful Operation

(12) Selecting the Vehicle.—General requirements; types available; factors affecting selection; body design; trailers; demountable bodies; special bodies; tires.

(13) Dispatching and Routing.—Fundamental principles; scheduling; co-ordination of loads and vehicles; zone system; analyzing routes by time studies; minimizing delays at ferries, terminals, etc.; selecting of routes; loading and unloading devices.

(14) Cost Keeping.—Importance; desirability of uniform system; results desired; data necessary; National Standard Cost System; Commercial Vehicle System; other systems.

(15) Maintenance.—Serious effect of improper maintenance; lubrication, inspection; effect of over-loading; effect of overspeeding; typical systems of maintenance; garage problems.

(16) European Transport Methods.—European transport problems and their solution; application to American conditions.

(17) Safety.—Grade crossings; guard rails; footpaths, etc.

(18) The Human Element, Forms and Record Systems, Etc.—Importance of esprit de corps and how to maintain it; typical bonus systems; mechanical checking devices; bills of lading, etc.

V—Selling Transportation

(19) The Cost of Transportation.—Factors entering into complete cost of transportation; crating; terminal charges, etc.; effect of road conditions on cost of highway transport.

(20) Economic Surveys.—Purpose; surveys of business operations; public haulage surveys; community transportation surveys.

(21) Industrial Uses of the Motor Vehicle.—Farming; lumbering; mining; factory; construction.

(22) Transportation Uses of the Motor Vehicle.—As feeder to railways and waterways; flanged wheel equipment; intercity trucking companies; rural motor express; motor buses; local uses.

(23) Exhibits.—Highway, rubber and automotive exhibits.

A Comparative Report on Rubber Tire Exports

SOME thirty sizes of metric tires, twenty of inch-size fabrics and twenty-two of inch-size cord tires are included on the export list. This was shown in a recent statement made by the Rubber Division of the Bureau of Foreign and Domestic Commerce, listing the exports during two representative months of last year. The figures were compiled from reports to the Rubber Association of America, Inc., representing more than sixty individual firms. The two-month record shows the variation in percentage. Its chief interest is in the sizes and in the comparison of clincher and straight-side. Three-fourths or more of the fabric tires, inch size, are shown to be of clincher construction, while more than four-fifths of the cord tires were straight-side. The figures follow:

Metric Sizes	Per cent total for July	Per cent total for November
700 x 80	.5	8.8
700 x 85	.2	.3
750 x 85	...	...
710 x 90	2.6	1.8
760 x 90	4.7	1.4
810 x 90	3.3	1.3
910 x 90	...	...
760 x 100	...	.8
810 x 100	*	*
870 x 100	...	*
765 x 105	2.0	3.1
810 x 105	...	...
815 x 105	9.9	22.8
875 x 105	2.4	5.1
915 x 105	...	*
815 x 120	.9	2.3
820 x 120	24.7	9.1
875 x 120	.4	.8
880 x 120	32.9	13.1
920 x 120	4.7	4.0
1020 x 120	...	...
815 x 125	.7	...
875 x 125	...	...
820 x 135	1.0	4.8
880 x 135	2.6	6.7
895 x 135	1.3	4.5
920 x 135	.1	...
935 x 135	4.4	3.6
895 x 150	.5	5.7
935 x 150	.2	*
Misc.	*	...

*Negligible quantities.

Inch Fabrics Sizes	Per cent total for July		Per cent for November	
	Clincher	Straight-side	Clincher	Straight-side
30 x 3½	*	...	...	...
28 x 3	19.7	...	.3	...
30 x 3	42.6	...	21.5	...
31 x 3½	...	...	...	...
31 x 3½	...	...	54.7	...
31 x 4	7.3	...	6.9	x
32 x 4	*	1.0	x	3.1
33 x 4	*	4.5	.1	3.7
34 x 4	...	.9	...	.8
36 x 4	...	...	...	...
32 x 4½	...	14.3	...	2.4
33 x 4½	*	.3	...	.6
34 x 4½	...	1.2	x	.5
35 x 4½	...	.5	...	.3
36 x 4½	...	.2	...	x
33 x 5	...	*	...	.8
34 x 5	...	...	...	...
35 x 5	...	.1	...	.5
36 x 5	...	...	...	...
37 x 5	...	*	...	x
Misc.	5.0	...	1.9	x
Total	74.6	25.3	85.4	14.5

*Sizes marked thus amount together to a total of 1/10 of 1%.

x Sizes marked thus amount together to a total of 1/10 of 1%.

Cord Tires Sizes	Per cent total for July		Per cent total for November	
	Clincher	Straight-side	Clincher	Straight-side
30 x 3	...	...	...	...
30 x 3½	16.5	...	11.1	...
32 x 3½	...	2.2	...	2.5
31 x 4	.2	...	...	3.5
32 x 4	...	7.3	...	5.5
33 x 4	...	10.4	...	9.5
34 x 4	...	2.8	...	2.1
32 x 4½	...	27.0	...	28.6
33 x 4½	...	7.2	...	4.8
34 x 4½	...	8.2	...	7.6
35 x 4½	...	2.96	...	2.6
36 x 4½	...	.7	...	.9
33 x 5	...	2.6	...	6.0
34 x 5	...	.2	...	.5
35 x 5	...	5.6	...	8.2
37 x 5	.04	.9	...	1.5
36 x 6	...	3.2	...	2.7
38 x 7	...	1.3	...	1.5
40 x 8	...	.7	...	.4
42 x 9	...	...	...	...
44 x 10	...	...	...	...
48 x 12	...	...	...	...
Misc.	...	...	...	.5
Total	16.74	83.26	11.1	88.9

Labor Courts Do Not Solve Problem

Ten States are planning to pass bills modeled after the Kansas Industrial Court law. Despite immediate advantages such courts do not go to the heart of the problem. Labor and rewards should not be standardized.

By Harry Tipper

THERE are pending in ten states bills modeled along the lines of the Kansas law for the establishment of industrial courts with the expectation of eliminating strikes. The effect of the Kansas law has been considered satisfactory by many people interested in the subject, and there is a definite agitation for further laws of this type. The American Federation of Labor is very active in combating these laws and a large part of the time in the hearing before Committee of the New York Legislature was devoted to the speeches of Gompers and others from the Federation ranks against the introduction of such a bill. The industrial court, as it has been established, has not eliminated the strike, although it has undoubtedly prevented a good many strikes from maturing and has lessened the losses incident to many of the local strikes which occur frequently from trivial causes and without any sound reason.

This method of dealing with industrial disputes does not prevent the dispute at all, or do anything to take away the original reasons for disputation. It simply attempts to limit the dispute and to impose a settlement before the production is stopped by the impossibility of agreement. It has many advantages, but it is not a cure-all for industrial troubles as so many sponsors seem to feel. It must take into consideration only general conditions involved in the strike and these conditions invariably resolve themselves into wages or hours of labor, etc.

One of the important difficulties in modern business is the standard of wage and the tendency to classify all workers of a group by the same standard compensation. Laws of this kind tend to legalize this classification and to further standardize compensation. This is not desirable.

The whole weight of modern study of the labor problem should be put upon the development of the industrial unit as an organization and, therefore, the elimination of separate classifications of workers and management. Otherwise the differences that are continually disturbing the industrial fabric will continue, in spite of industrial courts, national conferences or other means of adjustment.

The factory is not an organization as it stands at present, and it cannot be an organization until the spirit and machinery of organization is such as to provide a common viewpoint and object through the entire working force. None of the legal methods so far proposed are of any value in this particular, and no systems could be suggested of a general character which would be of any value.

While the introduction of these bills before the legislatures of ten states is indicative of the activities of many people who are looking for a short cut to the millenium of industrial peace, the progress of experiments in individual industrial organizations is a very much more important indication of the real tendency of affairs. Since the earlier profit sharing and employee representation experiments were developed, there have been established in the United States over 1300 such systems in individual factories or other establishments. From the progress of these experiments and from their influence upon surrounding conditions, we shall be able to study the possibilities in increasing human efficiency and organization unity much more closely. The wide diversity in the character of these experiments, the common object of organization building which inspires them, and the common desire for increased efficiency which maintains them, offers a hope of progress not exhibited in any of the general systems and legal suggestions so far put forward.

On the surface, the problem of securing labor efficiency and a reasonable degree of stability and contentment is not so acute as it was in the after-war period to the middle of 1920. Statistics show, however, that almost as many strikes have occurred of late as occurred in the previous period, and the general record of the movement of labor does not suggest that the problem is different from what it has been.

The introduction of these bills before various State Legislatures indicates a revival of the tendency to introduce legal restrictions upon the industrial settlement of these matters, a tendency which we have referred to many times in AUTOMOTIVE INDUSTRIES. The hearings which have occurred indicate a lack of interest on the part of business in the progress of political action upon labor matters. There are a number of individuals and groups actively engaged in promulgating the idea of industrial courts for adjustment of disputes, and of other legal machinery for the settlement of industrial disturbances. It will be necessary for business men to analyze these suggested methods and determine, with a full knowledge of the situation, if they are likely to prove of value. Otherwise, the corporations in various states may find themselves limited in their organization development, and in their discussions and conferences with bodies representing labor, by the legal machinery provided by the state. Because of the fact that these methods are being proposed in so many states, an analysis of the original Kansas law would be interesting and important to manufacturers. We shall undertake this in an article in the near future.

Despite the advantages from an immediate standpoint, the establishment of industrial courts does not present a solution of the matter and in some particulars is to be questioned.

One point should be understood very thoroughly in connection with all general means suggested for legislative action regarding industrial disputes. All industrial courts, national adjustment conferences, or other legal bodies, will tend to encourage the formation of labor and employee associations, unions or other bodies, because the necessities of the work of adjustment will require the affected parties to associate themselves more closely, in order to use their combined strength in disputes.

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Systems

INCREASING competition and the difficulties in finding a market for a large automotive production are lending impetus to the study of markets. To do this many different systems of definite values will be instituted and others which will prove invaluable after a tryout, but in any event the action decided upon must be carried through to a conclusion.

Information on marketing subjects is only valuable in so far as it is accurate. The system employed to obtain market information is only valuable in so far as it is rigidly adhered to by those persons who are responsible for carrying it on. Following the action through entails a careful and constant checking up on the system, and this should be done by authorized representatives who realize the necessity for accuracy.

Much can be done to make employees realize the importance of perpetually keeping up a system by giving them an insight as to its object and instill respect for it by a businesslike checking up.

A system which is allowed to "run to seed" does nothing but breed contempt for itself and expense for the company. If such laxity is continued it becomes increasingly difficult to gain co-operation for any system whether its value is apparent or not.

Fundamental Research

THERE are so many industrial problems requiring fundamental research that the automotive manufacturer can scarcely be blamed if he fails to find time in the course of a busy life to follow in detail the various developments. In another sense, however, there is no business more important to the permanent progress of industry than the proper conducting of just this fundamental research and the proper interpretation of its results.

Fuel research, for example, is vital to automotive development. Although some of the work going on may seem a bit super-scientific to the average executive, he can well devote time and effort to fostering and encouraging such efforts by responsible agencies, for upon the successful solution of the problems involved depends in a great measure the future of the automotive industry.

Standardization work, although involving chiefly engineering problems, has a definite bearing upon commercial development. The elimination of waste in manufacturing and selling is being investigated and constitutes another problem for fundamental research of vital character.

Labor and unemployment research is about to be carried on under Herbert Hoover's supervision in a manner never before attempted in this country. The research is now being outlined and when completed will be of extreme value to industry, provided industrial managers furnish the essential co-operation in gathering the necessary data. This survey will first take account of what is shown by the present inadequate statistics concerning unemployment. Data will then be compiled showing types of unemployed, unemployment problems that require further data, under-employment, an index of employment, relation of unemployment to business cycles, and present social cost of cyclical employment. On the basis of this data conclusions will be drawn, the various proposed remedies will be analyzed in the light of the facts developed, and plans for future improvement will be laid out.

While all these researches are slightly removed from the very immediate daily problems of the executive, they are concerned with vital questions pressing for solution in the very near future. The data which they are designed to develop are essential to the efficient and progressive functioning of the automotive industry.

Advertising Appeal

"THE appeal to snobbishness in automobile advertising is a dead letter. Prospective buyers want to know what transportation service they get for their money." Such was the statement made recently by an advertising man handling high-class accounts. It is a fact that many manufacturers of cars in the upper price group use the appeal of exclu-

siveness as their strongest selling talk. This brings forward the question whether the advertising man's statement was wrong or whether he was just one jump ahead of the crowd. It remains to be seen.

It is evident that prospective buyers of cars in the lower price group are weighing values as never before. The question arises whether the same searching tests for value are being applied by the prospective purchasers of high-priced cars.

Luxury and refinement of appearance have always been more or less stressed in high-priced car advertisements, while the idea of sustained fine performance has been used in a minor key. Is this the best way to sell the cars? Is it not possible that many people would buy high-priced cars if they realized that they were buying more than luxury of appointment and appearance? Are there not many people that appreciate high quality to whom exclusiveness carries little weight?

The increasing refinement in the medium-priced car makes it imperative to give a close examination to the selling argument of refinement. A careful analysis of the reasons for the sale of each high-priced car would undoubtedly furnish much information of value in determining just what advertising appeal will bring in the greatest return.

What Do Dealers Want?

THE last year and a half has seen a survival of the fittest among dealers. Dealer turnover has been high in many car organizations. Competition for good dealers is on the increase. The need for efficient and sound dealers has become a necessity. These facts make it interesting to analyze what factors in a manufacturing organization are likely to be attractive to the best type of dealer.

Dealers are just human beings, so it may be laid down as a general rule that the best type of dealer will react favorably to the same sort of appeal as will the best type of man in general. Considering this in conjunction with the necessity for more efficient marketing, it would appear that practical co-operation in the solution of marketing problems will be one potent appeal. The appeal made by one car manufacturer, for instance, in seeking new dealers illustrates well the sort of constructive, sane help that is likely not only to help build a good dealer organization, but also to go far toward reducing marketing costs. This manufacturer in attempting to sell his franchise to dealers, advertises in part as follows:

"How profitable is a Blank franchise? What can I make? How many prospects in my territory? Are sales increasing? These and many other questions will be gladly answered by our Opportunities Department. This department devotes itself to surveys of territories now having Blank representation and those where openings exist.

"It does not generalize, but gives facts. It can show, in actual figures, what results have been obtained in different territories. But it will be glad to study your own community very thoroughly and show you what can be expected."

The company which knows most about its market is in the best position to allot territory and to take on dealers to the mutual profit of all concerned. Knowledge and facts are coming to play a larger part each year all along the line of automotive marketing.

The $348 Car

FOR years Ford has stood supreme in the low-priced passenger car field, and through the establishment of a wonderful production plant and organization, an unusual marketing system, so far as the sale of cars is concerned, and a liberal service policy, has come to occupy a position which has been thought unassailable by many who are presumed to know the trade. Emphasis has, however, always been placed upon the production of a completely standardized product, the design of which has remained practically unchanged for a decade, while many competitors have incorporated refinements which the public has learned the advantage of having. This has proved a highly profitable commercial policy for Ford, who has been able to sell all the cars he could build during most of this period, but has in a way played into the hands of his nearest competitors in the price scale, who have had good arguments to advance in respect to features not incorporated in the Ford chassis and body. A large proportion of the car users in this country have appreciated and been willing to pay for refinements, many of which were prohibited under the policy which Ford has followed.

Now comes Durant, with wide experience in the industry, and, with the aid of parts makers whose combined facilities are perhaps as great as Ford's and rather more flexible, announces a plan for the production at Ford's present prices, of a car which incorporates many of the refinements and other features which have come to be associated with cars in the next higher price scale than the present Ford.

This, of course, has created intense interest upon the part of the whole passenger-car industry and resulted in much speculation as to what move Ford will make when and if the new competitive factor is developed to the extent anticipated. It also furnishes food for thought as to the probable effect upon the market for cars in the next higher price class than that directly involved.

The parts makers have long been a large factor in the automotive industry, and may be on the road to becoming a still larger element. On the other hand, Ford has apparently found it more desirable to make than to buy most of the components in his cars, and now follows this practice to a large extent. Whether experience will ultimately prove that a similar course is expedient in the case of the new product shortly to be placed in production remains to be seen. The results of the new venture will in any case be watched with great interest, and will, it seems certain, serve to heighten competition in the low-priced car field. However, Ford has a long start and a reputation for rendering real service to the users of his product—a policy which those who seek to compete with him cannot afford to overlook, and may well emulate.

1,000 Daily Output Planned for "Star"

Predicted Production Facilities Alone Will Limit Sales—Orders for June Delivery

NEW YORK, March 13—The new Star which was unveiled at Washington last week and which will be shown at Boston this week in the show rooms of the Collins Motor Car Co. already has created a considerable sensation in the automotive industry. Keen observers have no hesitation in saying that its sale will be circumscribed only by production facilities.

It is the ultimate purpose of Durant Motors Inc. to turn out 1000 a day and the Star will provide the first real competition Henry Ford ever has had.

Standard Parts Used

The question of service has not been neglected. The car will be built entirely of standard parts which will be available within a few hours in any section of the country. These parts will be carried in stock in the chains of parts service stations and sub-stations which are being established by the leading unit parts makers either individually or in groups. This service, with that which will be supplied by the dealers, will be entirely adequate, it is felt.

Parts makers, their plants and personnel have played an important part in the development of the Star. It is understood that it was the original idea that they should have some share in the making or distribution of the line, but it now is stated that they are to have no financial interest in the enterprise except as an outlet for their products.

It can be said, however, that the manufacturers of all the units which will be used are co-operating to the fullest possible extent. The first step in this direction was in setting prices which would permit the assembling of such a car at such a price. The second step was in arranging for uninterrupted and adequate production facilities. It now is believed there will be a steady flow of materials to the factory.

Financing Production

Fundamentally, although not actually, the parts makers may be said to be financing the enterprise. In other words, no large expenditure of capital by Durant Motors apparently will be necessary. For example, suppose enough parts to turn out 1000 complete cars are shipped this week by the various purveyors. Within another week these supplies will be at the factory. They will be assembled into complete vehicles and shipped with bills of lading attached within another week. The bills of lading will be deposited in the bank, and Durant Motors will be able to discount its bills.

This condition prevails, however, with any company turning out a car in which only specialized parts are used. The parts makers really finance all these manufacturers. It means that these car builders are not required to expend large sums in building and equipping factories. No overhead expense of this character is necessary. With parts bought in huge quantities at the prices Durant is getting, the ultimate cost probably will be less than it would be if he made all of them himself.

In connection with this car, which will compete only with Ford and which is expected to sell in very large quantities, the parts makers can well afford to make a low initial price because of the parts replacement business which will come to them eventually through service stations.

Parts makers insist that their relations with Durant in this respect will be no different than with the builders of other specialized vehicles. They deny emphatically that they have entered into any formal combination. Those in the group which have arranged for the establishment of a chain of service stations point out that these stations also will be available to persons using any vehicle in which these parts are used. They insist that they regard Durant only as another customer.

(*Continued on page* 639)

129,500 CARS AND TRUCKS MADE IN FEBRUARY: IS 44 PER CENT INCREASE OVER JANUARY

NEW YORK, March 14—Production of passenger cars and trucks by all makers for February is estimated at approximately 129,500. This was an increase of approximately 39,000 or about 44 per cent over January. The monthly production figures since June, when they first became available, follow: July 176,336, August 180,781, September 158,314, October 147,544, November 116,349, December 78,995, January 90,486 and February 129,500.

February shipments of passenger cars and trucks, including driveaways converted into carload equivalents, were 215 per cent of February 1921. Factory shipping figures for the first two months of 1920, 1921 and 1922 follow:

	Carloads			Driveaways			Boat		
	1920	1921	1922	1920	1921	1922	1920	1921	1922
January	20,057	6,485	15,241	29,283	3,185	7,397	....	93	154
February	25,505	9,986	19,600	43,719	7,507	9,950	....	99	169

Bethlehem Stockholders to Investigate Failure

ALLENTOWN, PA., March 13—An organized effort to save something from the wreck of the Bethlehem Motors Corp. was decided upon at a meeting here of New York and Allentown stockholders. Although the session was secret, it was announced that Alexander A. Bibighaus had been elected charman and given power of attorney to prosecute if it was found anyone was criminally responsible for the $2,000,000 failure.

The company was founded by Martin E. Kern, who later purchased the German interests in the Bosch Magneto Corp. and who now is in Europe. Clinton E. Woods, a former New York photographer, who was appointed receiver, said in his latest report that the liabilities were about $2,400,000 and that there was small prospect of a dividend exceeding 20 per cent.

Executives Consider Site for Frontenac

Detroit Makes Overtures—No President Selected, But Directorate Is Increased

INDIANAPOLIS, March 10—Allan A. Ryan, chairman of the board of directors of the Frontenac Motor Car Co., and W. N. Thompson, also a director of the new company, as well as the president of the Stutz Motor Car Co. of America, spent yesterday in viewing and inspecting proposed plants for the manufacture of the Frontenac.

Two extensive industrial plants are said to be under consideration for the home of the car, but it is said that no definite selection has been made. Thompson's interests in the new company are expected to be the determining factor in locating the company here, despite overtures from Detroit.

To Continue Temporary Offices

During the formative period the temporary quarters in this city will be continued. This is a plant with which Louis Chevrolet, designer of the car and vice-president of the company, has been identified. No president has yet been selected, but additional directors have been announced. One of these is Kenneth Howard, New York capitalist, who is listed as secretary-treasurer. William Rand, Jr., also of New York, has been named to the directorate. It is said that several men of prominence in local automotive circles will likewise be identified with the organization.

What is said to be the first experimental car went through trials on the Speedway yesterday, Louis Chevrolet driving.

It is reported that all the major units that will go into production, which is hoped to be on a large basis, will be built here. It is emphatically stated that the job will not be an assembled one. Although no figures as to the list price of the car are being quoted at this time, spokesmen for the company say that the organization will give the city a passenger car built in a popular price class that will necessitate quantity production.

Sharp Upward Turn Is Noted in Sales

Dealers Are Encouraged and Factories Feel Effects of Their Optimism

By JAMES DALTON

NEW YORK, March 14.—Production of passenger cars and trucks for February showed a material increase over January. The gain probably was as large as that of January over December, which was about 40 per cent, exclusive of Ford. Output was very much larger than in February, 1921.

Highly optimistic reports in regard to the volume of orders received continue to come from Detroit. They are accompanied by announcements of increased production. Several companies, including Dodge with 600 a day, Maxwell with 200 a day, Studebaker 400, Cadillac 100, and Hupmobile are approaching maximum production. Ford is speeding up his output both at the Ford and Lincoln plants. Chevrolet has fixed a schedule which calls for an output of 50,000 by July. The Rickenbacker is going into quantity production and the output of Durant fours is being speeded up as rapidly as possible. Other companies which are increasing their schedules are Reo, Paige, Dort, Columbia, Liberty and Wills.

Employment Improves

Employment in Detroit has shown a steady increase week by week since the close of the inventory period after Jan. 1. Employment in automotive plants is slowly but steadily increasing in all parts of the country.

There has been a sharp upward turn in sales at retail, both cars and trucks, in all sections. As a consequence dealers have been greatly encouraged and their optimism has been passed along to the factories. March always marks the real opening of the spring selling season, however, and April was one of the best months last year.

Predictions made in some quarters that the four months ending June 1 may establish a record for production undoubtedly are exaggerated although the volume of business will be large. The industry is establishing itself on a solid foundation for a long period of moderate prosperity. Notwithstanding a belated reduction here and there, it is evident prices have been fairly well stabilized. They are not likely to move sharply in either direction for several months.

While it has been expected that cultivation of the agricultural districts for sales in the fall would be profitable, this market for automotive products is producing business on a moderate scale months earlier than had been anticipated. Demand is becoming apparent for cars in the lower price classes and for light delivery trucks.

Business of parts makers naturally is reflecting the better tone apparent in the vehicle building field and the scope of operations is being steadily expanded. The same is true in tire plants where production costs have been lowered by greatly increased labor efficiency.

Financial Position Stronger

In spite of very heavy losses taken on inventories, the financial position of the industry at this time is stronger than was believed possible a few months ago. No important companies are in serious difficulties.

Every effort has been made to reduce liabilities and an enormous sum has been paid in the aggregate on bank loans and merchandise accounts. While the loss of $38,000,000 by General Motors on the year's operations seems exceedingly heavy, that corporation is in reality in a much stronger position today than it was a year ago and a very satisfactory profit for this year is assured.

Kentucky Wagon Plans for Merger Are Maturing

LOUISVILLE, KY., March 13—Details in the transfer of the Kentucky Wagon Manufacturing Co.'s properties of the Associated Motor Industries, Incorporated, are expected to be completed and operations begun at the Louisville plant under the new arrangement within thirty days, James R. Duffin, attorney for the company, said last night.

Twelve or fourteen large automobile companies will be in the new corporation. Those united in the merger which have not yet made their conveyances are preparing to do so, according to Duffin.

The stock division in the new corporation will be $40,000,000 shares of preferred and $40,000,000 shares of common.

The Wagon company's executive committee in charge of reorganization plans yesterday sent out notices to creditors to obtain formal consent to go into the consolidation, and their approval of the arrangement.

INSURANCE FIRMS DISSOLVED

NEW YORK, March 13—A Supreme Court order has been signed directing the State Superintendent of Insurance to take possession of the Motor Car Mutual Fire Insurance Co. and the Motor Car Mutual Casualty Co. It is alleged that the companies are insolvent and that the management has been guilty of misconducting the business. The court order dissolves both companies.

Schuette Transfers German Air Patents

Acquired by New American Corporation—Plans Developed for Commercial Lines

WASHINGTON, March 13—Announcement is made by Dr. Johann Schuette, president of the Schuette-Lanz Airship Co. of Germany, that he has signed contracts giving the General Air Service Co. the manufacturers' rights and patent interests of the Schuette Lanz airships for the entire world. This contract is expected to result in the virtual transfer from Germany to the United States of the large rigid airship building industry.

The General Air Service, which recently was incorporated for $50,000,000 under the laws of Maryland, plans to start service with two large passenger and express carrying airships between New York and Chicago. The service ultimately will be extended to the Pacific coast and possibly to South America and Europe.

Two new Schuette-Lanz airships are to be designed for the General Air Service Co. Tubing and some other materials will be fabricated in Germany, but the ships will be assembled in this country where other materials will be made. Promoters of the company assert that these dirigibles will use helium instead of hydrogen gas and oil instead of gasoline to drive the engines. In discussing helium, Dr. Schuette said:

Schuette Discusses Helium

It will be unnecessary to change the construction of rigid airships to permit the use of helium. Helium has 92½ per cent of the buoyancy of hydrogen. The guarantee of absolute safety from explosion and conflagration leaves out of consideration the small loss in lifting capacity.

It is perfectly feasible to valve helium, when necessary, by compressing it into retainers, and letting it escape back into the bags as the operating requirements dictate. In that manner the helium will not be lost.

It is one of nature's great favors that the United States seems to be the one country supplied with helium in sufficient quantities to make its extraction economical. This is as it should be, because the extent of the United States within its own continental limits is so enormous that rigid airships are a prime factor in its air navigation. They are essentially long-distance craft, and not economical for routes less than 500 to 700 miles in length.

STABILIZING CONFERENCE

WASHINGTON, March 14.—Exhaustive inquiry into methods of stabilizing industry is to be made by representatives of trade associations who will meet in Washington next Tuesday with members of the United States Chamber of Commerce, the Department of Commerce, and the Committee of the President's Conference on Unemployment. The purpose of the investigation is to find a solution as far as possible of business depressions and practical means to prevent them.

Studebaker Reports 1921 Largest Year

Net Sales Aggregated $96,690,644 with Profits Available of $10,409,601

NEW YORK, March 11—The profits earned by the Studebaker Corp. in 1921 were the largest in the history of the company, according to the annual report submitted to the stockholders. Sales showed an increase despite the depression of the year.

Net sales for 1921 totaled $96,690,644, as compared with $90,652,362 in the year previous. Net profits available for the common and preferred stock aggregated $10,409,601. The balance available for the common shares was $9,723,091, or the equivalent of $16.20 a share on the $60,000,000 common stock outstanding. In 1920 the corporation earned $15.20 a share on the common stock.

Record Year for Sales

The company established a record in its history in the number of sales made, the total reaching 66,643 cars, which was a gain of 29.5 per cent over 1920, when 51,474 sales were made.

After the payment of all dividends, $5,523,691 was added to profit and loss surplus, increasing that item to $18,279,744. The surplus at the close of 1920 was $13,467,048. Total current assets were $38,974,732, and net current liabilities $10,248,395.

The detailed income account for 1921 and 1920 is as follows:

	1921	1920
Net sales	$96,690,644	$90,652,362
Cost of mfg., etc.	84,158,347	78,521,555
Net earnings	$12,532,297	$12,130,807
Interest received	138,149	120,014
Net profit	$12,670,446	$12,250,821
Excess profits taxes	2,260,755	2,428,767
Bal. for dividends	$10,409,691	$9,822,054
Preferred divs. 7%	686,000	710,150
Bal. for common	$9,723,691	$9,111,904
Common dividends 7%	4,200,000	3,937,500
Surplus	$5,523,691	$5,174,404
Previous surplus	9,882,048	20,925,583
Total surplus	$15,345,739	$26,099,987
Transfer to special surplus account	405,000	405,000
Net losses 1921 anticipated, etc.	719,995	872,940
Stock dividends	.....	15,000,000
Total deductions	$1,115,995	$16,277,940
Final surplus	$14,229,744	$9,822,048
Spec. surp. account	4,050,000	3,645,000
Total surplus and special surplus	$18,279,744	$13,467,048

Looks for Better 1922

A. R. Erskine, president of the company, in his remarks to stockholders said: "The management believes that business this year will show a substantial increase over that of last year." Production schedules, it was said, called for shipment of 25,000 cars for the first quarter of this year, compared with 11,620 in the first quarter of 1921.

Erskine further said:

The inventories of the automobile division at the beginning of the year amounted to $26,853,948, including 2,932 finished cars. At the end of the year these inventories had been reduced to $21,872,885, including 4,507 finished cars.

On Dec. 31, 1921, there were 1,301 preferred and 5,959 common stockholders, as compared with 1,254, and 6,591 respectively on the same date of the previous year.

Last year the average number of employees on the corporation's payroll was 13,065 as against 13,583 in the previous year.

CLARK EQUIPMENT CO. OFFERS POETS $1,000

BUCHANAN, MICH., March 13—The Clark Equipment Co. which dedicated to the automotive industry last year 12 paintings by eminent artists, depicting "The Spirit of Transportation," now has offered a prize of $1,000 for the best poem or ode on the same theme.

The company proposes to publish full color reproductions of the series of paintings, accompanied by a suitable poem or ode. The board of judges which will award the new prize will be composed of Glenn Frank, editor, Century Magazine; William Stanley Braithwaite, editor, "Anthology of Magazine Verse"; Merle Thorpe, editor "The Nation's Business"; Frank W. Roche, publisher, "Automobile Topics"; Samuel O. Dunn, editor, "Railway Age"; Harold L. Brown, editor, "Bus Transportation."

Full details of the competition and a registration blank may be obtained by addressing the Clark Equipment Co., Buchanan, Mich.

Detroit Exchange Hears Good Report on Columbia

DETROIT, March 9—Columbia Motors Co. has orders on hand for 4000 new light six cars for delivery before July 1, members of the Detroit Stock Exchange were told yesterday at a special meeting staged by advertising counsel of the company. This action was taken to establish the position of Columbia stock on the local exchange, which has shown steady gains in the past two weeks.

The brokers were told that the new manufacturing plans of the company have been approved by financial interests and that production plans were complete. Distribution contracts were declared to have been placed already in 20 important centers.

Columbia, it is understood, will specialize on the manufacture of the new light six model and will discontinue its other lines as rapidly as its manufacturing and merchandising policies warrant.

White Takes Losses; Position Is Strong

Reduction in Inventories Entails Charge of $2,048,023—President Sees Good Year

CLEVELAND, March 11—The White Co. reports a loss of $2,346,824 in its operations during 1921, but nothwithstanding this it entered the new year in a strong position in respect to cash, inventories and back debts. The purpose of writing off losses on inventories entailed a charge of $2,048,023, which, with manufacturing loss and interest, made the full loss of the year $4,837,319.

The company paid $2,000,000 dividends, taking the money from surplus. The full charge against surplus was $6,837,319, bringing that item in the balance sheet down to $2,661,663. Chiefly through a decline of inventories, working capital was reduced in the year from $20,692,277 to $14,431,931. The bank loans were cut in two, as shown in the following table of income and balance sheet items, the loans being carried as notes payable:

	1921	1920
Sales	$30,320,948	$51,998,122
Loss	2,346,824	*3,486,704
ASSETS		
Inventories	$13,351,452	$22,989,073
Cash	1,346,441	1,472,329
Accounts receivable	2,838,393	4,859,038
Notes receivable	2,571,731	2,026,976
LIABILITIES		
Notes payable	$3,600,000	$7,200,000
Reserved for cont.	1,000,000	2,000,000
Surplus	2,661,663	8,472,312

*Profit from operations.

The usual quarterly dividend of $1 a share was declared yesterday, payable March 31 to stockholders of record March 21. Walter C. White, president, said after the directors' meeting that the business outlook was favorable, orders having shown a marked increased since October.

FEDERAL SALES $3,268,468

DETROIT, March 11—Federal Motor Truck Co. for the year ended Dec. 31, 1921, reports total sales of $3,268,468, compared with $10,628,742 in the previous year, giving net profits of $176,800 against $745,879 in 1920, the latter figure being subject to an estimated Federal tax of $200,000. The comparative balance sheet shows cash in 1921 of $165,301 against $163,293 in 1920; receivables, $256,209 compared with $228,811 and inventories of $1,521,050 against $2,497,398. The liabilities include accounts payable of $104,440 in 1921 as against $352,734 and dealer deposits of $23,985, compared with $31,844 in 1920.

NEW GOODRICH TIRE

AKRON, March 11—The B. F. Goodrich Rubber Co. has a new model "55" clincher tire made in 30 x 3 and 30 x 3½ sizes only. The larger of the two sizes will retail at $10.90.

British Overland Sustains 1921 Loss

Inventories, However, Were Reduced Substantially—Cash on Hand Greatly Increased

LONDON, March 4 (*By Mail*) — Crossley Motors, Ltd., of Gorton, Manchester, builder of Crossley "25" and "10.6" cars and, for a short time, a British Bugatti model, reports a trading loss for the year ended Oct. 31 of £234,965 gross and £224,296 net against a profit of £35,643 in 1920. The bulk of the common stock is held by Crossley Brothers, Ltd., which accentuates that company's loss on its year's business.

Willys-Overland-Crossley Co., representing the Anglo-American fusion since 1919, lost £96,486 gross and £84,275 net in 1921 against a profit of £112,210 in 1920. The stock price at date of issue was 21s. 6d. per share; it has dropped to 6s. 6d., or more than 62 2/3 per cent. Nevertheless the prospects of this company appear better than those of Crossley Motors, Ltd., because while on Dec. 31, 1920, inventories stood on the books at £708,697, they had been reduced last December to £348,602, and cash on hand was increased from £295 to £206,251.

Crossley Brothers, Ltd., is an old-established maker of oil and gas engines. In 1920 it made a profit of £59,112 plus £42,681 brought in from the previous year, and carried forward £51,161. The latest year's report shows a loss of £94,916 gross and of £42,855.

Truck Firm's Loss

LONDON, March 4 (*by mail*)—Halley's Industrial Motors report a loss on last year's trading. This is attributed to the dumping of many thousands of surplus Government trucks, often sold at prices barely more than the cost of freight for new vehicles. The company, anticipating a revival in trade, has increased its range of vehicles to various carrying capacities between 2 and 6 tons.

Hupp Motors Places New Order for 10,000 Bodies

RACINE, WIS., March 13—Industrial conditions in this city, which is one of the principal automotive production centers in the West, are reported to be improving markedly, considering the stagnation of recent months. Racine produces passenger cars, trucks, tractors, engines, parts, farm operating equipment and similar commodities with world-wide reputations, so that this present betterment of conditions is regarded as significant.

The H. & N. Body Corp., which started work Jan. 1 on an order for 10,000 bodies for the Hupp Motor Car Co., has received a supplementary order for another 10,000 bodies, delivery on the 20,000 to extend over 1922. In addition the concern has substantial orders from the Mitchell Motors Co., Racine. The H. & M. company is owned by the Hupp and Mitchell corporations, from which it derives its name. It is employing 650 people and part of the plant is on an overtime schedule. Skilled workers are being employed in the metal finishing department as rapidly as they present themselves.

The Harvey Spring & Forging Co. has taken contracts for furnishing all springs for the Nash Six and Four, the Mitchell and the Case for the current season, and is gradually increasing its force of 175.

MILWAUKEE DECLINES TO BUY ARMY SURPLUS

MILWAUKEE, March 13—Opportunities and offers to purchase army motor truck equipment from salvage or other sources have been declined by the city of Milwaukee in consideration of the question of providing twelve additional trucks of various types for municipal departments.

A special committee of the common council reported that the experience of other cities with army trucks was not satisfactory. Of the 173 motor vehicles of all kinds now in service in Milwaukee municipal departments, not a single army truck appears.

International Truck 1921 Profits, $126,931

NEW YORK, March 14—The International Motor Truck Corp., for the year 1921, reports net earnings of $126,931 after all taxes, interest and inventory adjustment. This is equal to $1.16 a share on its first preferred stock, against $2,644,013, or $3.98 a share on the common, in the previous year. The sales for 1921 reached a total of $24,849,268, as compared with $34,071,365 in the previous year.

The balance sheet as of Dec. 31 last shows profit and loss surplus of $9,258,700, against $10,323,422 at the close of 1920. Accounts receivable were $5,639,901 against $3,472,348. Inventory was valued at $9,675,583 against $15,588,848.

President A. J. Brosseau, in his remarks to stockholders, stated: "Orders on hand and prospects for business justify the belief that the sale of Mack trucks during the coming year will be at a greater rate than in 1921."

PARISH & BINGHAM CORP.

BOSTON, March 13—The Parish & Bingham Corp. reports for the year ended Dec. 31, last, a total operating deficit of $356,000 against $262,296 in 1920.

The net sales in 1921 reached a total of $4.201.124 compared with $9,128,443 in 1920. The cost of sales was $4,037,468 in 1921 and $9,089,813 in 1920, leaving an operating profit of $163,656 in 1921 and $38.630 in the previous year.

The deficit after dividends was $356,080 in 1921 and $712,296 in 1920.

Chandler Profits for Year Decline

Inventory Was Reduced Materially, Annual Report Shows—Ample Surplus Helped

CLEVELAND, March 11—Chandler Motor Car Co. for the year ended Dec. 31 last reports gross profits on sales after deducting cost of material and manufacturing expenses, etc., of $1,890,319 as compared with $9,440,326 in the previous year, net income of $41,017, equal to 14 cents on the 280,000 common stock of no par value, against $4,213,111, or $15.04 in 1920, and a deficit after dividends of $1,918,983, as compared with a surplus of $5,588,111 in the previous year.

The balance sheet as of Dec. 31 last shows cash $538,448 against $949,791 on Dec. 31, 1920; accounts receivable, $131,845, compared with $492,474; inventory, $2,773,742, contrasted with $5,788,504, and total assets and liabilities of $13,255,570 against $16,611,509.

Many Economies Effected

In his remarks to the stockholders, President F. C. Chandler says:

The year 1921 was the only year since starting business that found the company with an excessive inventory and a large stock of cars in hands of dealers.

We were fortunate that prior to this depression we had built up a surplus fully ample to carry business through a period of this kind and maintain a strong financial position. We effected many economies and were able to make extensive reductions in overhead expenses to permit us even with limited operations to carry on business with a fair operating profit.

All our financing has been done without aid of any large amount of borrowed money, and recent improvements in business, especially since Jan. 1, have been such that all current obligations at Dec. 31, 1921, have been paid, that portion of taxes which became due also was paid, and bank loans reduced by $500,000 to date of this report.

Second Offering Ordered for Obenberger Property

MILWAUKEE, March 13—A second offering has been ordered made on March 20 of the property of the bankrupt John Obenberger Forge Co. at West Allis, Milwaukee County. But one bid was made at the first public auction conducted by J. F. Gerdis, trustee, this being by Adolph H. Weidner, attorney, on behalf of secured creditors, in the sum of $233,000, which the bankruptcy court ruled as inadequate to cover assets appraised at $955,242.

The Weidner offer was to pay $48,000 in cash and assume liens aggregating $185,000. The explanation was that under present industrial conditions the assets have a market value far below the real worth. The liabilities of the Obenberger company are estimated at approximately $800,000.

Higher Tire Prices Predicted at Akron

Manufacturers Say Upward Revision Will Do Much to Stabilize Market

AKRON, MARCH 13.—Predictions that tire prices will be increased within the next 30 or 60 days are being made by Akron manufacturers. They contend that a study of balance sheets of tire companies will disclose plainly why higher prices are necessary and will afford justification for them.

Manufacturers contend that an upward revision would do much to stabilize the market and disabuse dealers generally of the erroneous impression that another reduction is in prospect.

The downward trend of tire prices, started last May by the B. F. Goodrich Co. and quickly followed by practically all large and small competitors, brought reductions which made tire prices at the end of the year 1921, approximately 40 per cent lower than at the beginning of the year. The new prices were also lower than before the war, and lower than in 1910, with the 1921 tire producing twice the mileage of the 1914 tire and three times the mileage of the 1910 tire, thus giving the motorist more tire miles per dollar than ever before.

Operating Costs Lowered

Scarcely had the last of these price reductions taken effect, than the price of raw materials used in tire manufacture began steadily to climb. The tire companies were forced to make drastic cuts in operating and overhead expenses. Office forces were pared to the bone. Sales forces were greatly reduced, territories were expanded and salesmen were compelled to "double-up." Finished goods inventories were also reduced to the lowest point for many years. In many factories the finished goods inventoried in the latter part of 1921 were smaller in tire units than the number of tires these same companies the year before had kept in transit.

Manufacturers claim the steady climb upwards of raw material prices, coupled with the absolute fundamental necessity for increased revenue so as to avert deficits in 1922 and so as to permit resumption of dividend payments, make the contemplated price increases justifiable. Forces can be reduced no further. Factory forces are down to rock bottom. All poor workmanship has been weeded out and only the most proficient tire builders have been kept. This has increased efficiency to a large degree but has not been sufficient of a saving to the companies in wages, to offset the 40 per cent reduction in gross sales revenues as occasioned by price cuts last year.

SUES PORTAGE STOCKHOLDERS

AKRON, March 14—Thirty-nine stockholders of the bankrupt Portage Rubber Co., now the property of the Seiberling Rubber Co., have been sued by W. E. Young as attorney for George D. Bates of Akron, trustee in bankruptcy, for a total of $46,000, said to represent the unpaid portions of their subscriptions for Portage stock prior to the company going into receivership. The amounts being sued for range from $400 to $4,800.

Miller Rubber 1921 Sales Gain But Profits Decline

AKRON, March 14.—Although sales of the Miller Rubber Co. for 1921 showed a 5 per cent increase in volume over sales of 1920, the Company reports a net loss for 1921 of $91,986 and a total deficit on Dec. 31, 1921, of $1,290,604 according to the annual statement and balance sheet given to stockholders at their annual meeting here.

While sales in volume exceeded those of 1920, in gross revenue, due to the series of tire price cuts enforced last year, 1921 tire sales were only $18,983,677 as compared to $26,182,391 in 1920.

The company, according to the annual balance sheet, reduced its inventories from $9,321,803 to $3,981,922. After writing down its inventories and deducting an amount considered adequate to cover doubtful accounts, discounts and contingencies, the current assets of the company amount to $7,983,224 less current liabilities of $2,060,437 (all bank indebtedness being paid), which gives the company approximately $5,922,237 net working capital or 31 cents on each dollar of the net volume of business the company did last year, according to President Jacob Pfeiffer.

Brighton Mills Sued for Seiberling Stock

AKRON, March 13—Suit to gain possession of $45,000 worth of stock in the new Seiberling Rubber Co. has been filed in the Summit County common pleas courts in Akron against the Brighton Mills Co., a New Jersey corporation, by the By-Products Realization Co. of Chicago.

The By-Products company alleges that the Brighton Mills Co. was a creditor of the Portage Rubber Co. of Barberton which has been acquired by the Seiberling Rubber Co. and that the defendant company owed the plaintiff $45,000 for services rendered last year. It also sets forth the claim that the Brighton Mills Co. agreed to pay the plaintiff in Seiberling stock, which it received in settlement of its claims against the Portage Rubber Co., and that payment has been refused.

BRADE LEAVES AUSTIN

LONDON, March 1 (*By Mail*)—Sir Reginald Brade, former secretary of the War Office, has resigned from the board of the Austin Motor Co., Northfield, Birmingham.

Gordon McGregor, Ford Executive, Dies

Head of Canadian Company — Succeeded Father as Walkerville Wagon President

DETROIT, March 13—The plants of the Ford Motor Co. both in Detroit and Windsor will be closed to-morrow when the funeral of Gordon M. McGregor, president of the Ford Co. of Canada, will be held. McGregor died Saturday. He was 40 years old and had served for almost 20 years as president of the company which he organized in 1903.

McGregor succeeded his father as president of the Walkerville Wagon Works in 1903. The company was in financial straits and McGregor interested Henry Ford in forming a Canadian branch of the Ford Company to take over the Walkerville Wagon plant. A company was capitalized at $125,000 with rights to sell in all parts of the British Empire, except the British Isles. Ford for his patents and sales rights received 51 per cent of the stock. This has since been reduced to about 20 per cent.

The plant began operations in 1904. In the second year only 110 cars were manufactured and of these 76 were exported. Then business boomed. In 1911 the capitalization was increased to $1,000,000 and in 1916 to $10,000,000. Employees now number 14,000.

No time has yet been set for the directors to act upon the death of McGregor. Wallace R. Campbell, secretary, assistant treasurer and assistant general manager, is looked upon as the most likely successor.

R. & V. Motors Opens Branch at Its Factory

EAST MOLINE, ILL., March 13—In line with the success of its retail branches in Chicago, Boston, Baltimore and other automobile trade centers, the R. & V. Motor Co. has opened a factory retail sales and service department, adjoining its main factory building. B. N. Ward and D. S. Smith are in charge.

Reports from branches and distributors, officials say, indicate a 1922 business eclipsing that of 1921, when the R. & V. plant was one of four manufacturers whose sales exceeded 1920 and second only to one other in higher percentage of increase.

The factory is now working full time with practically a normal force, and production is at a rate greater than last year.

LOWER PRICED WASHINGTON

EATON, OHIO, March 11—The Washington Motor Co. has stopped production on the light six model priced at $1,635 and is at present working on a design for a lower priced car to sell for about $1,275. The heavier model is being continued.

Milwaukee Reports Better Conditions

Car Manufacturers Increase Delivery Specifications on Standing Parts Orders

MILWAUKEE, March 13—A slight but gratifying increase in delivery specifications on standing orders held by Milwaukee automotive parts manufacturers from the various passenger car factories has been a feature of the past week's business. Some new orders placed likewise have brought about a better feeling.

During January and February parts makers were just about able to hold their own in the matter of production, but it appears that since the national and local winter shows have portrayed the possibilities of demand, and the effect of the local shows has been to increase retail sales, which has been reflected into distributors' orders, car builders are proceeding on a broader basis.

There is nothing particularly striking or sensational about the present improvement in the local parts industry, save that it means a recovery from a sort of trough into which it found itself during the between-season period from the holidays until the beginning of March. A survey of the general situation of Milwaukee industries, wholesale and retail business, indicates that lost ground is steadily being regained. Unemployment is again being relieved, especially in the general iron, steel and machinery trade.

Local Trade Better

Although here and there comes a fresh jolt in the form of a new price reduction announcement by passenger car manufacturers, the demand here is making progress and dealers believe that a point has been reached where the position of prices may again be called stable, or nearly so.

Those handling the makes within a range from $950 to $1,500 are now doing a better business than at any time since last July or August, judging by sales so far in March. The higher priced lines, who were relatively more active than others in the last four or five months, are holding their own. Ford dealers report gains, with prospects more inclined to close pending deals.

Prospective buyers still have something to learn about the obvious pursuit of used car values in relation to new car prices at the reductions which have been made, but the lower level of used car allowances is gradually becoming better understood.

IMPLEMENT EXPORTS GAIN

WASHINGTON, March 10—Exports of agricultural implements and tractors for the first month of 1922 show an increase of $314,208 over the month of December, 1921, according to a special report by the Agricultural Implement Division of the Department of Commerce. There is reason for encouragement in the fact that the statistics for January indicate an upward trend of exports. The chief decrease in January, 1922, as compared with January, 1921, when the total exports were $7,320,277, was in plows and cultivators, and mowers and reapers.

FORD WILL PRODUCE 400 TRACTORS DAILY

DETROIT, March 13—The Ford Motor Co. will increase its tractor production to 400 daily in April, thereby doubling the present output. All parts of the country are represented in the increased business, the distribution being through the regular channels. Production of cars and trucks is 34,000 ahead of production last year at this date. January assembly at the plants approximated 40,000, against 30,000 last January. February production was 52,649, compared with 30,305 last year.

Trade Reviving in West, Cadillac President Wires

DETROIT, March 13—H. H. Rice, president and general manager of the Cadillac Motor Car Co., who is on a trip to the far West, wired the factory from Spokane, Wash., that even to the "ultra conservative" element indications of a business and trade revival are clearly discernible in the West.

"The more optimistic are outspoken in predicting very much improved business for about all the West," Rice reports, after analyzing the situation as he has seen it in Nebraska, Colorado, Montana, Utah, Oregon and Washington. His message continues:

Cattle, hog and sheep feeders are making good showings. The copper mines have opened after a long shutdown. Prices for all live stock and for wheat are much better. Shipments of lumber are greater than for months. Money is easier, and, best of all, people begin to feel that a distinct change for the better has really taken place.

The automobile business generally can expect a much better condition than in 1921, and Cadillac particularly will show a very substantial increase.

Durant Canadian Program Calls for 12,000 Output

TORONTO, March 11—The first car produced in the plant of the Durant Motors of Canada, Ltd., Leaside, was delivered to E. A. Wallberg, Toronto representative. The Leaside plant is now equipped and ready for quantity production and all cars to be absorbed by the Canadian market will be manufactured there. The present year's schedule calls for between 12,000 and 15,000 automobiles.

Within the next few days a considerable number of Durant cars, now in process of construction, will be shipped from the Leaside plant and distributed throughout the Dominion.

Credit Men Discuss Retail Time Sales

More Careful Selection of Dealers Suggested to Bring About Better Paper

NEW YORK, March 10—The cost of financing retail time sales cannot be materially reduced, except through the improvement of the character of paper sold to the finance corporations. This opinion was expressed by F. G. Rawson, vice-president of the Commercial Credit Co. of Baltimore, before a meeting of the Automobile Financing Credit Men's Association, which is allied with the National Association of Automotive Bankers.

Better paper will result through the education of the dealer as to the best way to sell on time and get paid for it, it was suggested, and through the more careful selection of dealers by the manufacturers. Under present conditions collection costs and the losses of revenue on delinquent payments are so high that it is impossible to reduce the rates.

Rawson favored the financing of the dealer's stock of cars by his own bank. However, he did not think that the dealer should use his line of bank credit for financing retail time sales. A further disadvantage is that the bank has no machinery for collection, and, in case of a delinquent payment, the note comes back to the dealer for collection. This is the thing the dealer wants to avoid and can avoid through the use of a finance corporation.

The types of instruments required for retail time selling in the various states due to the variations in legal practice were discussed by P. W. Haberman, vice-president of the Commercial Investment Trust Co. The conditional sale contract is used in all states except Ohio, Missouri, Colorado, Michigan, Louisiana and Pennsylvania. The chattel mortgage is used in all of these states except Pennsylvania, which requires the bailment form.

10 Carloads of Tractors to Be Shipped by Eagle

APPLETON, WIS., March 13—The Eagle Manufacturing Co., manufacturer of the Eagle tractor, has booked orders in the last two weeks for about ten carloads of tractors, four being for Canadian shipment and the others for Pennsylvania, Ohio, Indiana and Michigan.

According to Charles J. Hagen, general manager, indications are that present tractor prices will never be lower, and a material advance may be expected after June 1, by which time it is expected that the supply now on hand, which was carried over by manufacturers, will be exhausted and new production will be on a basis of present material, labor and manufacturing costs, as compared with present "pressure" prices. Hagen regards the outlook for the remainder of the year as good.

Offices of Chrysler Bear Maxwell Name

Former Willys Executive Has Mapped Out No Definite Program for Future

NEW YORK, March 14—Walter P. Chrysler has returned from a brief vacation at Palm Beach and opened offices in the Equitable Trust Co. building on Madison Avenue. The name on the door will be the Maxwell Motor Corp., of which he is chairman of the board.

Chrysler said to-day he had not mapped out a program for the future. He will devote a considerable share of his time to the affairs of the Maxwell and Chalmers companies, but also will give considerable attention to his own affairs, which have been neglected in the past two years.

While Chrysler does not propose to cast aside altogether business responsibilities, he does propose to rest a great deal more than he has for a long time. In addition to his duties as executive vice-president for the Willys enterprises, he had much of the responsibility for working out the reorganization of the Maxwell and Chalmers properties.

In connection with reports that Cleveland interests are negotiating for the purchase of the "Chrysler Six," which was to have been made by the Willys Corp., it was stated by Chrysler that he had withdrawn the right to use his name in connection with this enterprise and that while the receivers of the Willys Corp. can sell the engineering rights in this car, the name does not go with them.

New Zeder Motor Co. Advancing Car Plans

CLEVELAND, March 13—Royal T. Hodgkins, manager of the Cleveland Tractor Co. and one of several Cleveland business men who are interested in the new Zeder Motor Co., said to-day that definite plans are under way for the manufacture of a new car, which will be known as the Zeder, in the plant of the tractor company in this city.

Hodgkins denied that the new company, which has been incorporated under the laws of Ohio with a nominal capital of $500, has under consideration the purchase from the Willys Corp. of the rights to the car which it was to have manufactured in its Elizabeth, N. J., plant.

It had been reported that preliminary steps to this end were being taken by Rollin H. White, president of the tractor company; Clement Studebaker, Jr., who severed his connection with the Studebaker Corp. ten months ago, and Fred Zeder, former chief engineer of the Studebaker organization and designer of what was to have been the Chrysler Six. It is stated, however, that Studebaker is associated with White in the new venture.

The car will be powered with an engine developed by Zeder.

WANTS NAME TO BRAND "JAY WALKER", DRIVER

WASHINGTON, March 14—The American Automobile Association wants a name that will brand reckless motorists just as "jay walker" brands careless pedestrians.

"A jay walker," it is explained, "'is a person not sufficiently civilized to cross the street at the proper crossings. He or she endangers public safety as well as obstructing traffic. The jay walker deserves prosecution, but even more effective is the ridicule carried by the term."

A similar name is wanted for rowdy and careless drivers to show them that they do not "belong," and it must be as comprehensive and have the elements that will make it as popular in its use as its pedestrian brother.

The association offers a $25 prize. The contest will close May 15 and the award will be made May 29. The Contest Editor is located at 1108 Sixteenth Street, this city.

Columbus Has New Firm to Make Truck Parts

COLUMBUS, March 11—The Bingham Manufacturing Co. has been incorporated with a capital of $100,000 to manufacture special parts for trucks and to assemble trucks. The company has taken over the East Livingston Avenue plant of the Immel Co., body makers, which went into the hands of receivers some time ago.

New machinery is being installed. Many of the parts are patented and are designed for special jobs. H. N. Bingham is president and general manager; F. E. Kocher, vice-president, and G. P. Hinkle, secreteary. Other incorporators are J. A. Shearer and James R. Spellman.

Agents Sign for Space at Show in Mexico City

MEXICO CITY, MEXICO, March 3 (*By Mail*)—Indications point to the success of the annual automobile show that will be held here, commencing April 16, under the auspices of the automotive division of the American Chamber of Commerce. W. F. Saunders, Jr., secretary of the chamber and likewise secretary of the show, stated to-day that fifteen agents already had signed up for space.

ALL METAL VALVE CO. FORMED

DETROIT, March 11—Articles of association of the All Metal Valve Co. were filed in this city yesterday, Frank L. Klingensmith, C. Malinz, Kansas City, and Frank F. Beall being shown as principal stockholders. The company is to manufacture a tire valve with a patented locking device. Capital stock is $200,000, with 2000 shares at $100 a share.

Bureau of Standards Revising Headlamps

Values for Lights on Road Increased Under Agreement with Society

WASHINGTON, March 13—Revision of specifications for headlights on automobiles has been undertaken by the Bureau of Standards, in co-operation with the committee on Motor Vehicle Lighting of the American Illuminating Engineering Society. An agreement was reached whereby the values specified for lights on the road were considerably increased, while the limiting values, which are intended to control glaring lights, were left unchanged. Other changes were also made.

As many devices approved under the present regulations would not satisfactorily meet the requirements of the revised ones, it is probable that these specifications will only be recommended for adoption at some definite period in the future, presumably two or three years.

Reports received by the Bureau of Standards show that the establishment of headlight adjusting stations in garages has been a very desirable step toward uniformity of automobile lighting. Automobile manufacturers are very much interested in regulations governing headlights used on motor vehicles and are assisting the Bureau of Standards and legal authorities in the United States which have framed laws governing the use of headlights. The Bureau is particularly desirous that there should be uniform treatment in all states.

Uniform Laws Needed

In order to secure a satisfactory degree of uniformity in all parts of the country, it will be necessary to have (1) uniform laws, (2) uniform procedure in the enforcement of the laws, and (3) an extensive campaign of education both for enforcement officers and garage men and drivers of automobiles.

With the idea of securing uniformity in the adoption of such regulations, an informal organization of state authorities representing the whole of New England, New York, New Jersey, Pennsylvania and Maryland has been formed. Another meeting of this organization will be held at Harrisburg in April, and it is understood that an attempt will be made to establish a board of officers who will be charged with the approval of devices in all the states represented.

KNOX TIRE PLANT SOLD

MT. VERNON, OHIO, March 10—The plant, equipment and other property of the Knox Tire & Rubber Co. has been sold at public auction by Trustee Paul M. Ashbaugh to F. G. Litsch of Middletown, Ohio, representing a group of stockholders of the company. The property had been appraised at $213,186 and was sold for $175,000.

1,000 Daily Output Planned for Star

Predicted Production Facilities Alone Will Limit Sales—Orders for June Delivery

(*Continued from page* 632)

The situation in a nutshell is that the leading parts manufacturers are seeking the expansion of their markets by fostering the sale and development of specialized vehicles. They are eager to do anything within their power to balance so far as possible the output of assembled cars as compared with that of the builders who make most of their own units.

It is not to be denied that some of the parts makers have given consideration to the question of extending a certain amount of financial backing to certain assemblers whose product possessed large sales possibilities. There even has been talk of accepting a share of the profits of these companies, but this plan has been abandoned. There will be no formal combination, it is said, for the present at least.

While orders are being taken for June 15 delivery of the Star, detailed plans for its distribution have not been worked out, but it can be stated that the policy will follow closely that of the Ford company and that no exclusive territorial sales rights will be given.

Plant Location Not Determined

While all cars are being sold at Ford prices, f.o.b. Detroit, the location of the factory has not been definitely determined. The freight rate from the entire Michigan manufacturing district is the same as from Detroit. It is probable the first cars will be made at the Long Island City plant.

Although no definite plans have been made for the manufacture of the Star, it can be stated that Durant engineers have inspected the Elizabeth, N. J., factory of the Willys Corp. Durant has been favorably impressed by this modern plant, but for assembly purposes it would be worth only a fraction of what it cost, and there is nothing as yet to indicate that he will decide to buy the property.

As already announced, the distribution, sale and servicing of the car will be in the hands of a company to be known as the Star Motor Car Co. This will be a subsidiary of Consolidated Motors, a Maine corporation which will serve as a holding company. Consolidated Motors was incorporated three or four years ago, but has been dormant ever since that time and recently was reincorporated. It has 2,000,000 shares of common stock at $10 par value. None of this stock will be issued to the public. It is assumed various other companies will be formed later as subsidiaries of Consolidated Motors. No information is available as to the stockholders either in the parent company or its subsidiaries.

N. A. C. C. RECOMMENDS CAUTIONS IN DRIVING

NEW YORK, March 14—The National Automobile Chamber of Commerce has suggested to manufacturers that they attach in some way to each car or truck sold the following cautions regarding the need for care in using motor vehicles:

1—Always remember you are an engineer, fully responsible.

2—Inspect your brakes at least once a month.

3—Never pass to the left of a street car.

4—Never pass a street car when it is stopping for passengers.

5—Always signal with hand when slowing down, turning or stopping.

6—Sound horn three times when backing.

7—Observe the traffic rules carefully; they are made for your safety.

26,840 Visitors at Washington

WASHINGTON, March 10—Actual count showed that 26,840 visitors inspected the new Star when it made its debut here. Durant expressed himself as highly pleased with the number and the interest shown. Salesmen declared that several hundred people had expressed their intention to purchase the car as soon as it has been put on the market.

R. H. Harper has been named distributor for this territory.

35,000 at Boston

BOSTON, March 14—Approximately 35,000 persons have viewed the new Star, Durant product, when it was shown in this city. It was stated that orders were taken at the rate of one a minute. The car will be taken from here to New York the last of this week for a brief showing.

Shaler to Build Larger Plant to Replace Old

WAUPUN, WIS., March 13—Arrangements to build a new plant on a scale exceeding that of the one totally destroyed by fire March 3 are being made by the C. A. Shaler Co., manufacturing vulcanizers, tire and rubber repair equipment, headlight lenses and other automotive specialties. Although the loss was a heavy one, only a part of the damage of $300,000 to $350,000 being covered by insurance, the company will engage immediately in the rehabilitation of its productive facilities.

C. A. Shaler, founder and president of the company, was in California at the time of the fire and wired instructions to R. B. Dunlap, secretary and sales manager, to proceed with reconstruction as early as possible.

French Compound New "National Fuel"

900 Parts of Gasoline Contained in Mixture to Be Given Competitors in Test

PARIS, March 1 (*By Mail*)—A mixture composed of 900 parts high-grade gasoline, 100 parts 95 degrees alcohol, 17.5 parts cyclo-hexanol, and 37.5 parts phenol, will be given to the competitors in the "national fuel" competition to be held near Beziers on April 2.

These trials, which form part of a big movement to secure home-produced fuel for France, consist of a 250-mile road test for all types of cars, which are given a determined amount of the above fuel according to their piston displacement and weight. The winner will be the one traveling the greatest distance on this allowance, while maintaining the minimum average speed required in his particular class.

The mixture adopted for the Beziers competition, and designated "national fuel," differs entirely from the "national fuel" recently put on the market by the Government. This latter is composed of equal parts of alcohol and benzol.

Benzol Stocks Depleted

One of the results of the Government action in marketing an alcohol-benzol fuel has been to remove all benzol supplies from the French market. This has caused dissatisfaction among motorists, and particularly among the big taxicab proprietors. The Department of Commerce has issued an official statement to the effect that the French production of benzol is only 800 tons per month, and practically the whole of this is used by the producers. Owing to adverse exchange rates, supplies cannot be obtained from England and America.

Under the terms of the Peace Treaty, Germany is obliged to deliver 2500 tons of benzol to France every month. The whole of this is monopolized by the Government for making its "national fuel," composed of 50 per cent alcohol, 50 per cent benzol. The Government is anxious to get this fuel on the market in order to exhaust its big stocks of alcohol, but is not meeting with much success. The Paris Omnibus Co. is using the Government fuel, but the taxicab companies and private owners refuse to have anything to do with it.

Cadillac, Detroit Founder, to Be Honored Annually

DETROIT, March 14—The celebration of the anniversary of Antoine De La Mothe Cadillac, founder of the city of Detroit, by the Cadillac Motor Car Co., proved to be so successful that it will lead to the institution of an annual Cadillac day by the company. Distributors throughout the country joined in the celebration.

Strike Will Retard South African Trade

Demand for Buses and Tires Forecast, However—Country Reports Good

JOHANNESBURG, UNION OF SOUTH AFRICA, Feb. 6 (*By Mail*)—The motor industry has not suffered as much from the coal and gold mining strike as was expected at the outset. In fact, the street cars in this city have been unable to operate for many days because of the lack of coal. Motor transport, therefore, has carried citizens from and to their homes. All types of motor vehicles have been in use, from heavy trucks to taxicabs and automobiles. This has resulted in reducing the stocks of tires on hand.

Johannesburg has never had many motor buses because the street cars, being operated by the municipality, have a monopoly. It is anticipated that after the present experience the municipality will order a number of buses in the event of any future tie-up in street car transportation.

Air Will Be Cleared

Following the present trouble, things are bound to be bad for some months and very few new cars may be sold. But it is thought that the strike will clear the air once and for all and put an end to the Rand's industrial strife.

Reports from the country districts are very encouraging and show that the farmers have more money to spend. For instance, Hupp Garages, Ltd., and the General Garage, Dodge Brothers agent, sold nearly as many cars in January as in the previous month despite the industrial situation. Most of these sales were in the country districts, although Johannesburg, Pretoria and Cape Town were responsible for a number of sales.

The 1922 Maxwell has arrived in South Africa and has been very favorably received. The Buick Four is still on the water and its arrival is awaited with interest. It is understood that a shipment of Nash Fours is also on its way. The Oldsmobile Four has met with a favorable reception and there have been a number of sales made in the coast towns. The latest model of the Hudson has arrived and there is no difficulty in disposing of the sporting models, which are great favorites in this country. Speedy cars are liked here despite bad road conditions.

More British Light Cars

A few more British light cars have been received and it is understood that others are on their way. These light cars, however, have a very limited market owing to poor roads.

American-made motorcycles find a market, although British machines are steadily gaining as the prices become lower. The Indian and Harley Davidson are the most popular of American makes and probably top the list of all motorcycles sold as regards quantity. The Excelsior is growing in popularity. The British A. J. S., Triumph, Matchless, Enfield, B.S.A., Coulson, Zenith, Douglas, and Norton are gaining in sales.

Car prices have been reduced considerably during the past month or two. Buick, Chevrolet, Ford, Hupmobile, Studebaker, Cadillac and Maxwell have all made downward revisions. Dodge Brothers have announced that a reduction retroactive to Jan. 1 will be forthcoming soon. While the Nash Six is still being quoted as during the war period, the price has always been far below that of its competitors.

M. EDWARD.

Marlin-Rockwell Corp. Organizes Subsidiary

NEW YORK, March 14—The Marlin-Rockwell Corp. has organized a subsidiary known as the Marlin Wire Wheel Corp. to take over the manufacture of the Rudge-Whitworth Wire Wheel, which has been manufactured under a license giving exclusive right to the use of that name in this country. The wheel has been manufactured heretofore by a division of the parent corporation, and it is believed formation of the new corporation will give impetus to sales efforts.

The Marlin Wire Wheel Corp. has as its president Guy Vaughn, who is president of the Standard Steel & Bearings Corp., another Marlin-Rockwell subsidiary, and general manager of the Philadelphia plant. H. C. Pryer is the secretary and treasurer.

New Soft Top Increases Demand for Closed Cars

DETROIT, March 14—The advent of the new soft top type enclosed car with its price differential of only a few hundred dollars from the open models, has brought the enclosed models into active demand, even with spring at hand.

Factories making the inexpensive enclosed models report a demand for these cars parallel with open model sales and in some cases exceeding them. The Essex, which was the leader in this field, is now paced by Hudson, Dodge and Hupp.

This demand has been so noteworthy that President J. D. Dort of Dort Motor Car Co. has made the statement that in his belief open cars will in the near future be almost entirely superseded by enclosed cars except in the cases of persons who keep more than one car.

JEWETT SEDAN AT $1,395

DETROIT, March 11—A second Jewett model just announced by the Paige-Detroit Motor Car Co. is a four-door, five-passenger sedan and sells at $1,395. All body panels are of steel. The joints are welded together over a framework of hardwood to form a seamless shell. This type of construction is said to permit the application of a standard finish to the whole exterior of the car.

All Models But One of Earl Are Reduced

Price Cuts Range from $90 to $200—Roadster Unchanged at $1485

NEW YORK, March 10—Reductions of from $90 to $200 on the Earl cars and delivery wagons were announced here today by factory representatives. The new and old prices are:

	Old Price	New Price
Phaeton	$1,185	$995
Sedan and brougham	1,895	1,695
Express delivery wagon	1,085	995
Panel delivery wagon	1,160	1,060

The custom-built roadster remains unchanged at $1,485, being the only model on the new Earl line that was not reduced. Extra charges of $15 for radiator thermometer, windshield wiper and bumper are announced on the phaeton and $30 extra for this equipment and heater and running board mats on the closed cars.

CHALMERS TO INCREASE $100

NEW YORK, March 13—The Chalmers Motor Corp. will increase the price of its various models by $100 on April 3. This increase will not apply, however, to the Maxwell models.

MERIT PRICES REDUCED

CLEVELAND, March 14—The Merit Motor Car Co. of this city announces today a price reduction from $1,985 to $1,895 for its five passenger phaeton and two passenger roadster.

DANIELS, $1,000 LOWER

READING, Pa., March 14 — The Daniels Motor Car Co. has made a straight reduction of $1,000 on all models of its line.

LOWER R. & V. PRICES

EAST MOLINE, ILL, March 15—The R. & V. Motor Co. announces a reduction of 10 per cent on the prices of the R. & V. Knight four and six cylinder models.

Irish Business of Ford Gains Under New State

DETROIT, March 15—Business of the Ford Motor Co. in Ireland has increased encouragingly since the establishment of the Free State. The company reports that Irish dealers forecast a much larger volume of sales throughout the year for Ford products. The plant at Cork is now furnishing cylinder blocks and other parts to the Manchester, England, plant, and it is stated that the Manchester product soon will be entirely British made.

Activities out of Manchester are expanding steadily, but sales in England have been confined largely to trucks and delivery vans, which are said, this year, to dominate the automotive field.

Exchange Retarding Trade with Hungary

Country Stands in Need of Motor Trucks—Market Also for Passenger Cars

WASHINGTON, March 11—The exchange rate in Hungary is practically the only drawback to the sale of American motor trucks in that country. A study of the situation by Vice-Consul D. A. Willson at Budapest shows that Hungary needs great quantities of motor trucks at this time to reduce transportation costs of essential commodities. He believes that medium priced trucks and passenger cars will find a ready sale as the exchange rate becomes more favorable.

Willson has produced figures showing that the supply of horses in Hungary has dwindled to about 37 per cent of the horses existing in 1918. Analysis of transportation costs showed that the cost of transport of one ton of merchandise by a 5-ton truck, with trailer attached, would amount to about 12 crowns per kilometer, as estimated by transportation men in Budapest.

Higher Rail Rates

The rate for transporting the same weight of merchandise by rail, without allowances for cartage and transfer, is 19 crowns per kilometer by fast freight, according to the Transport Tariff of the Hungarian State Railways, in force since August 1920—and a 100 per cent increase in rail rates is expected to be put in effect some time early in 1922.

The automobile manufacturing industry of Hungary has never prospered. It reached its highest point of productivity during the war when the government requisitioned plants for the manufacture of trucks for the army.

During the years from 1910 through 1920, the total number of motor vehicles manufactured in Austria was 2504, of which 409 were passenger cars and 2095 were trucks. These were the output of six factories, all of which manufactured trucks, but only four of which made passenger cars. One firm has not manufactured any motor vehicle since 1912; from 1915 through 1918 only one factory was making passenger cars and four or five were producing trucks; in 1920 four factories were operating, two manufacturing passenger cars and two trucks.

Scarcity of Raw Materials

It is believed that were it not for the difficulty of importing raw materials the Hungarian motor industry would be more successful, in view of the fact that the low rate of the crown and the corresponding low rate of wages would permit the exportation of cars to nearby countries with favorable results. However, at the present time the factories are working on a reduced scale because of the further fact that the transportation situation is most unsatisfactory, and there appears to be a general slump in the motor car market of Hungary.

The greater part of the motor vehicles used in Hungary are imported from other countries, and the business is carried on through the agents of foreign manufacturers. The first real influx of foreign motor vehicles began in 1905, due to the interest aroused by the Second International Motor Show held in Budapest during that year. Since that time the total importation of motor cars has been nearly four times as great as the entire domestic production.

About 85 per cent of the motor vehicles imported into Hungary, however, are never put into use in that country, but are re-exported to nearby countries. During the period from 1910 through 1920 the total number of foreign motor vehicles brought into Hungary and used in that country amounted to 784, of which 547 were passenger cars, 59 motor trucks and 178 motorcycles.

Report of Stewart-Warner Shows $767,411 Net Income

CHICAGO, March 14—After writing down inventories about $500,000 and making surplus adjustments, the net income of the Stewart-Warner Speedometer Corp. was $767,411, according to the company's annual report. After payment of $1,172,105 in dividends, there was a deficit of $404,694, which resulted in the surplus being reduced to $7,637,234 compared with $8,041,397 at the close of 1920.

The report states that business thus far this year was about 100 per cent above the corresponding period last year, that a normal production basis was being rapidly approached and that a satisfactory profit was expected this year.

N. A. C. C. Considering Joint Fuel Research

NEW YORK, March 15—Members of the National Automobile Chamber of Commerce have been informed that the directors are considering a joint fuel research plan by the N. A. C. C., the American Petroleum Institute, the Society of Automotive Engineers and the United States Government.

Based on the report that it is possible to produce a great deal more gasoline under certain processes than is now being done, the directors have authorized the appointment of a committee to examine what is known as the "Greenstreet Process" as it is in operation in some of the refining plants.

OHIO BODY REPORTS LOSS

BOSTON, March 15—The Ohio Body & Blower Co. reports a net loss for 1921 after charges and inventory adjustment of $558,660, as compared with a net loss of $397,338 in the previous year.

Net sales in 1921 were $1,531,468, as against $2,737,260 in 1920. The cost of sales, inventory adjustment, etc., reached a total of $1,601,397 in 1921, as compared with $2,479,540 in the year previous. The total operating loss was $391,568 in 1921 and $229,903 in the year before.

Scandinavia Calls for Parts Stations

American Exporters Must Establish Them to Offset Domestic Competition

WASHINGTON, Mar. 13—Study of the Scandinavian motor car industry by Commercial Attache N. L. Anderson indicates that American exporters must place a complete line of spare parts at a central distribution point in Scandinavia in order to offset domestic competition. He has reported to the Department of Commerce that there is a good field for automobile sales, provided the difficulties incident to obtaining spare parts are overcome. It is suggested that main service stations be located at Copenhagen, as it is a principal commercial center station of Scandinavian and Baltic countries.

Replacement, Great Problem

Anderson states that it is of utmost importance to the success of American business that some plan be devised to eliminate the replacement problems from which dealers are suffering, due to the distance from American factories.

The motor market in Scandinavia is still unstable. Financial conditions put the "Scania Vabis," the largest motor car manufacturers, out of business for several months. A reorganization is now being effected in Sweden under the name of Aktiebolaget "Vardsholmen." The factory in Denmark continues under the old name and has kept up the manufacture of gears.

Accordingly, it may be said that "Scania Vabis" is to-day out of business as an automobile manufacturing concern, but the high quality and former success of the "Scania Vabis" cars will probably bring about a further reorganization of the company for the renewed manufacture of automobiles when times are more normal.

Other Car Makers

De Forenede Automobilfabrikker (United Automobile Factories), with headquarters at Odense, Denmark, and a branch factory at Copenhagen, was started about five years ago by uniting three existing Danish automobile factories—the Thomas B. Thrige at Odense and the Anglo Dane and Jan in Copenhagen. This concern has a capital of 2,000,000 Kroners, employs about 200 workmen, and produces 200 cars annually under the trade name "Triangle." This output is almost entirely trucks, which are very substantial and economical in upkeep. Motor locomotives are also manufactured by this concern. The financial rating of the company is very good, in spite of the general bad condition of the local automobile market.

In addition, Kramper and Jörgensen (the "Gideon" motor cars) of Horsens, Denmark, and A/B Tidarholms Fabrikker of Sweden, have until recently been manufacturing automobiles in Scandinavia. Both these firms, however, are now out of motor car manufacturing.

Owner's Confidence Is Big Trade Item

E. K. McGinnis, Formerly With Packard, Says Service Is Important Factor

AUSTIN, TEX., March 11—"The automobile distributor must look at his business in the light of confidential relationship with his customers, as the doctor or lawyer with his clients; if he abuses the confidence he will lose future business."

This was the expressed opinion of Edward Karl McGinnis, formerly connected with the sales department of the Packard Motor Car Co. of Kansas City and now Professor of Business Administration in the University of Texas. McGinnis believes that there are three chief faults in the sales policies of automobile distributors.

He said:

"The greatest mistake, I believe, is in the service situation. When the demand for automobiles fell off in 1920 very decidedly, those companies that had been 'gouging' in their service policy were the first to find business leaving them. Many were forced to liquidation or bankruptcy on account of enemies made by their service policy."

McGinnis then explained the service policy by an example. In St. Louis a truck company, which later went bankrupt, left a monkey wrench in the rear axle of a truck. The wrench tore out about $1,000 worth of repairing for the purchaser. He brought the truck back to the manufacturer for reparing, and they charged him for the work, even though the break-down was due to their own carelessness.

As an exception to this questionable policy, McGinnis cited the case of the Ford factory. Ford, he explained, has a school at the factory for service men; the most experienced workmen in each distributing house would send in candidates for the school. Ford paid them regular wages while in the school, and gave them stiff examinations regularly on all work. Then they were sent back to their jobs. A uniform charge for all repair operations has been set.

Another mistake made, McGinnis said, is the trade-in policy. He then stated:

A third mistake is in the sale of cars on credit. They are sold on a basis of 15 to 20 per cent interest on deferred payments. But the interest charge is so mixed with the cost of insurance, and is a flat rate on the whole price of the car, that customers are deceived in many cases in the amount they thought they were paying.

NEW YORK PASSES FEE BILL

ALBANY, March 16—Increased registration fees for motor vehicles are authorized under two bills passed by the Assembly and sent to the Governor. One provides that the fee for passenger cars shall be 50 cents for each 100 pounds of the cars, fully equipped, weigh 3500 pounds or less, and 75 cents for each 100 pounds if they weigh more than 3500 pounds. The fee for all other cars would by $8. Motor trucks of two tons or less would be assessed $16, and the registration fees of all other trucks would be $8 for each additional ton.

MILWAUKEE MAY HAVE "TRACKLESS TROLLEY"

MILWAUKEE, March 13.—As the result of the success experienced by the Milwaukee Electric Railway & Light Co. in the operation of a number of motor buses as connecting lines to regular street car traffic arteries and similar uses the utility has now applied to the Milwaukee common council for permission by ordinance to place in operation a "trackless trolley" on Lincoln Avenue, which would be the first motor bus line using overhead trolleys for power in operation in Milwaukee.

Industry in Canada Shows Big Expansion

OTTAWA, ONT., March 14—The rapid expansion of the automobile industry in Canada is shown in a report issued by the Dominion bureau of statistics. The total value of production in 1920 was $137,420,351, an increase over the total figures for the previous year of $36,223,-645. The value of the automobile output in 1920 was over $101,000,000; of motor supplies and accessories, over $19,-000,000, and automobile repairs, over $16,-000,000.

The capital invested in the automobile manufacturing industry in the Dominion in 1920 was nearly $54,000,000, an increase of about $19,000,000 over the capital invested in the previous year. Registration of motor vehicles in use in Canada increased from 69,598 in 1914 to 469,-310 in 1921.

GORDON LEE IN CHICAGO

CHICAGO, March 15—Gordon Lee stopped here to-day on his western trip to talk to the Automotive Equipment Association on export possibilities. Lee's story of the new work being done by the Department of Commerce was largely new to these manufacturers. Especially were they surprised at the movement to describe the channels of trade in foreign countries and for aiding manufacturers to produce the kind of goods that could be marketed in these countries. There was also present at the meeting Paul L. Palmerton, chief of the Rubber Division.

TRAINLOAD OF WHITES

SAN FRANCISCO, March 15—More than 100 White motor trucks have arrived here on a fast freight train consisting of 45 cars consigned to mercantile firms, utilities or municipalities in various parts of the coast territory. In the trainload were trucks of four capacities, ¾, 2, 3½ and 5 tons.

Japan Is Preparing to Start Road Work

Leaders Confer with Samuel Hill —Country Convinced of Highway Needs

LOS ANGELES, March 13—It is expected that Japan this year will enter upon the comprehensive national road and highway building campaign which has been planned for several years. Samuel Hill, president of the Columbia River Highway Association and the leading spirit of the Pacific Highway Association, is now in Japan conferring with the Japanese leaders in the movement to establish a network of highways throughout the empire.

The carrying out of the program outlined holds great possibilities for the American manufacturers of automobiles, for just as soon as Japan, China and the other coutries of the Far East are "sold" on the value of good roads as the United States has been "sold," the Orient will become a market of tremendous fertility for motor vehicles. Hill says:

Japan has now reached the place where she is convinced of the need of good roads and rapid transportation. All nations preparatory to launching upon an extensive road building program must go through a period of education. Japan has gone through that, the same as America went through it and as many other nations have done.

In Japan all that remains to be done now is to organize the forces for carrying out such a program, to lay out a thoroughly scientific and proven method of construction, including the correlation of all the roads of the Empire, and then begin the actual work of construction. I am convinced this work will be undertaken later this year.

Use of Rail Declines in Transporting Stock

KANSAS CITY, March 13—The Monthly Review of the Federal Reserve Bank of Kansas City takes official cognizance of the radical increase in the use of motor trucks during the past few months for transporting livestock to the six principal markets in this District.

It is well known that the open winter has been propitious for the highway transportation of commodities, but no comment had previously been made on the actual extent of this practice, especially in its reference to railroad traffic. The Federal Reserve Bank, however, collating data on movements of stock, notes the decline in the number of railroad cars carrying stock to market.

The editor, however, did not rest content with that particular piece of information, but sought other data to round out livestock figures. The marked increase in numbers of animals received at yards "through the gates," that did not come by railroad, gave the cue—the "drive-ins," including both stock actually driven in on foot and that transported in vehicles, showing a marked increase.

MEN OF THE INDUSTRY

N. H. Van Sicklen, at one time publisher of Motor Age and latterly manufacturer of the Van Sicklen speedometer, has been appointed assistant general manager of Apperson Bros. Automobile Co. Van Sicklen is a pioneer in the industry, having been long identified with several of its branches. He is also well known nationally as a sportsman. T. E. Jarrard will continue as vice-president and sales manager.

Wilbur F. Opdyke, for a number of years connected with the Crescent Tool Co., Jamestown, N. Y. and later connected with the Walden Worcester Co. of Worcester, Mass., has been appointed district sales manager for the Ohio and Michigan territory for C. N. & F. W. Jonas, direct manufacturers' representatives to the jobbing automotive trade of a number of well known accessory lines.

F. W. Fenn, secretary of the motor truck committee of the National Automobile Chamber of Commerce, will address the engineering students of the Massachusetts Institute of Technology on March 24. He will speak before the Bay State Automobile Association on March 22, and will discuss the use of motor buses by traction lines before the New England Railway Club on March 23.

W. T. Helfer who has been ill for more than a year has fully recovered his health and is contemplating moving from Detroit where he is now living to Southern California, probably Los Angeles, to return to active work in the industry. Helfer is one of the veteran tire men of the country, being the first branch manager of the Diamond Rubber Co. in Boston.

Francis W. Davis, one of the best known men in the automotive engineering field, has resigned as consulting engineer of the truck department of the Pierce-Arrow Motor Car Co. with which he has been associated for several years. Other than leaving on an extended trip to Europe he has announced no definite plans for the future.

Frank J. Pardee, for many years identified with the automobile industry in Chicago and for a long period sales manager of the Diamond-T Motor Truck Co., has been named general sales manager of the Leach Motor Car Co. of Los Angeles, succeeding Roy D. Heartz who has retired from business.

C. W. Henry has joined the field force of the Elgin Motor Car Corp. as district manager in charge of the Minneapolis zone. He was formerly associated with Dodge Brothers and with the Maxwell-Chalmers organization in the capacity of district representative.

George C. Kloss, formerly eastern district sales manager of the Gillette Rubber Co., has been appointed special representative of the Delion Tire & Rubber Co. of Baltimore. Kloss has served with various tire companies since he first joined the industry in 1900.

W. H. Sackman who recently resigned as chief engineer of the Light Manufacturing & Foundry Co. of Pottstown, Pa., has been chosen a director and chief engineer of the Pennsylvania Gasoline Drill Co. of Philadelphia.

Earle T. Sutton, formerly advertising manager of the Denby Motor Truck Co. and having wide sales experience both wholesale and retail, has been appointed to the factory staff of the Signal Truck Corp., Detroit.

H. K. Wheelock has returned as managing head of the Western Vulcanizer Manufacturing Co., Chicago. Wheelock relinquished management a year ago on account of ill health and his duties were taken over temporarily by W. J. Jarratt.

E. Z. Jones, formerly director of sales of the Winther Motor Corp. and handling sales in 1921 for the Jackson Motors Corp., has been appointed New York branch manager for the Anderson Motor Co.

P. L. Palmerton, chief of the rubber division of the Bureau of Foreign and Domestic Commerce, will leave soon for Europe to make the first governmental survey of markets abroad for tires and other rubber products.

William C. Hunt, formerly advertising manager of the Columbia Motors Co., has become automobile editor of the Detroit Journal.

Guy Core, former sales manager of the Jackson Motor Shaft Co., has become assistant sales manager of the Reynolds Spring Co., Jackson, Mich.

Alfred Reeves, general manager of the National Automobile Chamber of Commerce, will leave Monday for a two weeks' trip to the factories of members of the organization.

J. Henry Smith has been appointed manager of sales of the automobile body department of the Pullman Co. with headquarters at Chicago.

F. B. Willis has been named sales manager of the H. C. S. Co., Indianapolis.

Wright Rubber Products Formed; Will Make Mats

RACINE, WIS., March 13 — The Wright Rubber Products Co., a new Racine, Wis., corporation with $300,000 capital, will start work immediately on the erection and equipment of a factory. It will make a wide variety of mechanical rubber goods, including mats for motor cars and running boards.

It will not, at least for the present, engage in tire and tube manufacturing. Clarence Wright, for many years connected with Racine tire and rubber companies, is president.

Senate Committee Favors Further Federal Road Aid

WASHINGTON, March 13—Continuance of Federal aid to states in highway construction is advocated in the report of the Senate Committee on Postoffices and Post Roads in the postoffice appropriation bill reported to the Senate. The committee recommends an appropriation of $50,000,000 for Federal aid during the fiscal year of 1923, and suggests the authorization of $65,000,000 in 1924 and $75,000,000 in 1925.

The committee declares that refusal to appropriate for 1923 means the abandonment of Federal aid. It also advocates an appropriation of $2,200,000 for air mail service from New York to San Francisco. The current appropriation amounts to $4,125,000.

FORD TITLE TO LINCOLN CLEAR

DETROIT, March 15—Federal Judge Tuttle has decided that Henry Ford has a clear title to the properties of the Lincoln Motor Co. and that any claims filed by the government must be settled by the Detroit Trust Co. as receiver for the old Lincoln company.

Boston Holds Last Big Sectional Show

Exhibit Clinches Impression From Other Parts of Country of Public Interest

BOSTON, March 15—Boston's twentieth annual show, the last of the industry's great sectional exhibitions this year, is clinching more firmly the impressions made by the ten weeks of shows preceding it that popular interest in motor cars is strong and that, aside from conditions peculiar to certain parts of the country, a sales volume in excess of 1921 may be expected during the remainder of the spring selling season.

Attendance has been satisfactory and has been increasing daily, the interest indicating a good proportion of potential buyers. New England dealers up to Wednesday night had registered close to 50 per cent of their numbers at the show, and most of the sales meetings conducted by the manufacturers and distributors have been well attended.

Sales Resistance Diminishing

Motor car dealers from the outlying communities brought encouraging reports of diminishing sales resistance due to price uncertainty and a more hopeful public attitude concerning general business conditions.

The trade in Boston proper and the adjacent territory is spotty. Dealers who have close, efficiently operating organizations are moving cars in fairly good volume right now. Some of them are piling up large spring delivery sales. The rest are showing some improvement over the sales of a year ago.

There is a note of increasing optimism in the truck section, due to the better general business tone of the territory, and all of the exhibitors expect the spring months to show a marked improvement in sales. In fact, selling already has reached good proportions in lighter trucks and business cars.

Few Motor Vehicles Made in Germany Reach America

WASHINGTON, March 15—Only 2.2 per cent of the 968 motor vehicles exported from Germany were received in this country during January, according to an analysis of foreign trade by the Automotive Division of the Department of Commerce. Holland was the principal country of destination, as 21.5 per cent of the German exports were taken across the frontier.

Exports from Germany showed a slight decrease as compared with December. Belgium accepted 17 per cent of the passenger cars, trucks and chassis (for both); Sweden, 9 per cent; Spain, 9 per cent; Denmark, 8 per cent; South East Asia, 6.6 per cent; South America, 2.7 per cent; Switzerland, 1.6 per cent; Austria, 1.5 per cent, and all other countries less than one per cent each.

FINANCIAL NOTES

Gray & Davis, Inc., for the calendar year of 1921, which was the first full year operated under American Bosch Magneto management, reports an operating loss of $179,594, compared with a deficit in 1920 of $468,108 and with a net profit in 1919 of $465,680. The Cambridge plant, with sales of $1,061,642, showed an operating profit of $6,980, and the Amesbury plant, with sales of $791,193, reported an operating loss of $186,574. In 1920 the net loss for the first seven months under the old management was $436,109, and in the final five months under the new management it was but $4,998, of which the Amesbury plant showed a loss of $53,215, and the Cambridge plant a profit of $48,216.

Maxwell Motor Corp. executive committee has voted to anticipate the maturity of the issue of approximately $3,850,000 series A gold notes due June 1, 1922, by retiring them under the call of privilege of April 1. The strength of the company's cash position is indicated by this action in retiring the notes sixty days before maturity. Maxwell carries no bank loans at the present time.

Reynolds Spring Co. of Jackson has declared a dividend of 1¾ per cent on the preferred A stock, payable March 31, 1922 to stockholders of record at the close of business on March 22.

Hupp Motor Car Corp. has declared its regular quarterly dividend of 1¾ per cent on preferred stock, payable April 1 to stock of record March 20.

Fisher Body Corp. of Ohio has declared its regular quarterly dividend of $2 on the preferred stock, payable April 1 to stock of record March 25.

Kelsey Wheel Co. has declared the regular quarterly dividend of $1.50 on the common stock, payable April 1 to stock of record March 20.

Meixell States Gasoline Tax Is Discriminatory

NEW YORK, March 15—Motor vehicle taxes upon gross tonnage and horsepower instead of upon gasoline purchases were advocated by Harry Meixell, secretary of the Motor Vehicle Conference Committee, in an address before the Oil Trades Association of New York. He said:

The main objections to the gasoline tax are that it discriminates against the internal combustion vehicle in favor of those driven by electricity or steam; that it fails to discriminate between the use of automobiles for pleasure and for business; that it is costly in administration and brings with it other and higher taxes upon the users of motor vehicles.

Without question, Meixell said, owners of motor cars should pay a share of the expense of maintaining highways, but only on the basis of gross weight and horsepower. He estimated that one-tenth of the motor vehicles in use in the United States are commercial trucks.

BOWSER TIME LENGTHENS

FORT WAYNE, IND., March 14—Scheduled hours for employees in the shop of S. F. Bowser & Co., Inc., of this city, pump and tank manufacturer, are now fifty a week, due to increased business. The day men will work nine hours a day for the first five days of the week and five hours on Saturday. The night men will work ten hours a night for five days a week, starting at 7:30 o'clock. Overtime will not start until the scheduled hours for the day have been worked. This is the longest work schedule in force at the Bowser plant for some time.

60,000, G. M. Output in First Three Months

NEW YORK, March 15—Production by the various General Motors divisions, including all types of motor vehicles, will approximate 60,000 for the first three months of this year, as compared with about 25,500 for the same period in 1921. The total output of all divisions for January were approximately 15,400, compared with 6000 in January, 1921.

February production increased to 21,000 as compared with 8900 for February last year. Buick continues to lead all other divisions. Business of the General Motors Truck Co. has not increased to the same extent and sales by the Samson tractor division have been small thus far this year.

Kelsey Wheel Co. Reports $16.06 Earned on Common

DETROIT, March 16—Although the gross sales of the Kelsey Wheel Co., Inc., showed a substantial decline during 1921, at $17,487,597, compared with $25,200,913, during 1920, the net profits are shown in the annual report, after charges and Federal taxes amounted to $1,792,862 equivalent, after providing for preferred dividends, to $16.06 a share earned on the $10,000,000 common stock.

Net profits during 1920 totaled $1,916,008, or at the rate of $17.24 a share. After payment of deferred dividends, there was a surplus of $1,606,109, as compared with $1,724,107 at the end of 1920.

MULLINS BODY CORP.

SALEM, OHIO, March 16—The Mullins Body Corp. for the year ended Dec. 31, 1921, reports net operating loss of $87,617 after expenses. Net sales during the year amounted to $1,431,243. Gross profits from sales after deducting cost amounted to $130,061. After deducting miscellaneous charges of $23,327 and expenses $217,678, there was a deficit of $110,392.

AVERY REPORTS DEFICIT

PEORIA, ILL., March 15—Avery Co.'s annual report shows a net deficit of $714,969 on operations and a total deficit of $2,657,827, after inventory adjustment and other expenses, compared to an operating profit of $17,355 in 1920.

The comparative balance sheet as of Nov. 30, 1921, shows accounts receivable, etc., of $1,243,713, against $817,625 in 1920; and inventory of $4,209,696 in 1921, compared to $7,010,994 in the previous year.

BANK CREDITS

Written exclusively for AUTOMOTIVE INDUSTRIES *by the Guaranty Trust Co., second largest bank in America.*

The trend of the call money market was generally downward throughout last week. The week's range was 3½ per cent to 5 per cent, as compared with 4 per cent to 5½ per cent in the previous week. For fixed date funds offerings were in better supply, although the range remained unchanged at 4¾ per cent to 5 per cent for all maturities from sixty days to six months. The prime commercial rate continued to be quoted at 4¾ per cent to 5 per cent. The plentiful supply of funds during the greater part of last week was principally due to the accumulation of money here for the March 15 turnover, which will include the payment of the first installment of the 1921 Federal Income Tax.

Further gains of $14,5000,000 of gold and of $13,200,000 of total cash reserves were shown in the Federal Reserve statement as of March 8, 1922. Total bills on hand decreased $70,309,000 and total earning assets $39,506,000. Total deposits decreased $38,391,000. Federal Reserve notes in circulation, on the other hand, increased $451,000.

The gold reserves of the New York institution increased last week $3,137,000. There was a shrinkage of $9,873,000 in total deposits. Federal Reserve notes in circulation showed an increase of $1,607,000, and the ratio of total reserves to deposit and Federal Reserve note liabilities combined increased from 84.1 per cent to 84.9 per cent.

Bradstreet's Index Number of commodity prices as of March 1 showed a further slight gain, the eighth gain shown in nine months in the general price level since early last June. The index numbers as of March 1 indicates a gain of 1.5 per cent over that of February 1 and of 8.5 per cent over that of June 1, 1921, but it is 2.2 per cent below the level of March 1, last year.

Proponents of Metric System Are Organizing

WASHINGTON, March 14—That proponents of the metric system are going to stimulate efforts looking to the establishment of this plan of measurement has become evident. An organization of the local section of workers for the installation of the metric system and the passage of the Britten-Ladd bill was effected last Friday night at George Washington University Law School.

It is also proposed to name an "educational" committee in order to acquaint the people of the country with the alleged benefits that would arise from the metric system. Senator C. F. Ladd, of North Carolina, spoke of an amendment to his bill which would provide that in 1926 all Government specifications and engineering works be done with the use of the metric system.

INDUSTRIAL NOTES

Deman-Myers Cord Tire Co. reported a bright outlook for the year at its annual meeting. The overhead expense has been reduced to the minimum, it was stated, and the company is now operating on the lowest cost possible and still maintain the efficiency of the organization. Full capacity production is planned, although conservatism will mark the company's program. F. F. Dugan, formerly with the Goodyear Tire & Rubber Co., has been elected vice-president and director of sales. C. L. Mason, sales manager, will be in charge of distributors and branches. Additions to the field force include J. H. Appleby who will cover Illinois and J. P. Egan whose territory takes in Ohio. The Board of directors elected the following officers: President, Walter E. Myers; vice-president, F. F. Dugan; secretary and general manager, Walter R. Denman; treasurer, John E. Morris; and assistant secretary and treasurer, L. M. Harper. The offices of the company have been moved from Cleveland to Warren, Ohio.

Ewing Bolt & Screw Co., Detroit, has acquired the plant of the **Detroit Machine Co.**, new capital being provided for the development of both concerns. Plans contemplate the sale of the Machine company's property and the construction of a new plant in the River Rouge near the Ford steel plant on a site owned by the Ewing Corp. Myles E. Ewing, president and J. A. Hale, secretary and treasurer of the Ewing company, assume the same offices with the Machine company. David W. Pell, manager of the Machine company becomes production manager of the Ewing concern. The directors are Hal H. Smith, Frank W. Blair, Arthur T. Waterfall, David W. Pell, A. N. Marion, Myles E. Ewing, J. A. Hale, all of Detroit; and H. J. Douglas and David L. Rockwell both of Cleveland, the latter being vice-president.

Perfection Heater & Manufacturing Co., Cleveland, at its annual meeting elected C. S. Pelton president and general manager, W. A. C. Smith vice-president and F. D. Kellogg secretary and treasurer. E. L. Jones was appointed sales manager and G. W. Rouvel, assistant treasurer. All directors were re-elected. The company reports business to be in a very satisfactory condition with bright prospects for 1922. A number of important changes are being made in its production equipment.

Kendell Engineering Corp., Fort Wayne, Ind., formerly the Kendell Engineering Co., has completed its plans for expansion under which it will begin operations immediately on a new plant. There has been no changes in personnel, C. A. Kendell continuing to act as president and engineer; Robert L. Kendell as vice-president and sales director and M. W. Cartwright as secretary and treasurer.

Carpenter Tire & Rubber Co., Hempstead, Long Island, is confining its business exclusively to the manufacture of solid motor truck tires. Production is now fully underway at its new plant. The company was formed several years ago as distributors, with Harry B. Carpenter as president and general manager. Associated with him is Harry Davenport as general superintendent.

Torbensen Axle Co. is establishing a chain of parts service stations, each station to be centrally located and to carry a complete line of the company's parts. It is planned to arrange these locations so that there will not be more than twenty-four hours delay in service. It is expected that the entire distributing organization will be completed within the next sixty days.

Lakeside Forge Co., Erie, Pa., has opened offices in the Penobscot building, Detroit, and at 334 North Capitol Avenue, Indianapolis, in addition to its present district sales offices in New York and Cleveland. These are industrial sales offices and are not in any way connected with the jobbing or dealer end of the business.

Tuscora Rubber Co., a $1,500,000 company making special rubber articles at Dover, Ohio, has been placed in the hands of C. C. Adams and Henry Krantz as receivers. The corporation was organized in 1919 and started operations in 1921. There are approximately 1,600 stockholders throughout Ohio and West Virginia.

Chicago Automobile Supply House announces a change in its personnel. William M. Weber is president and treasurer; Robert S. Mitten, vice-president and general sales manager and Otto H. Weber, secretary. The former secretary and treasurer, J. E. Brennan, has retired.

Kelly-Springfield Tire Co. at its annual meeting increased the number of directors from eight to twelve, the new members being C. A. Brown, T. C. Marshall, J. V. Mowe and M. Switzer. The old directors were re-elected.

New England Velie Co., Boston, is developing plans under which it will finance both wholesale and retail car sales.

E. Edelmann & Co. plant in Chicago has been sold to the Bassick Manufacturing Co. for $260,000.

Cleveland Fisher Body Plant Operating Full Time

CLEVELAND, March 14.—In line with the general improvement in automotive conditions here the Fisher Body Corp. plant is now operating on a full time basis and is turning out 200 bodies a day. Practically capacity production is the schedule, with 2,800 men employed. About six months ago the plant was practically closed down, after having been in production with about 3,000 men the latter part of 1920. Last October production was resumed on a small scale and it has been increased steadily.

At the plant it was reported that inquiries for bodies of the closed type have greatly increased.

The Baker R & L Co. has announced that business has reached 50 or 60 per cent of normal. The Ohio Body Blower Co. and the Rubay plants also report that inquiries have increased and that production gained during March.

The industry is responsible largely for the expansion of the Otis Steel Co. and the Empire Rolling Mill Co., both of which are going into the production of steel sheets.

REO ACTIVITIES INCREASE

DETROIT, March 13—Reo Motor Co. has placed its engine department on approximately full time production, and will increase its operations in other departments as the supply of engines is increased. Steady growth in orders is reported from all parts of the country. The new Reo special taxicab will be ready for the market within thirty days.

METAL MARKETS

Significant in the present condition of the steel market is the reaction which the announcement that certain producers of bars, shapes, and plates had revised upward their asking prices for these products had upon the mind of the industry as a whole. Not a few sales managers were frankly uneasy that the ado which was made about these advances might be misconstrued and tend to scare out of the market buyers of steel products prices on which never descended to the low levels of bars, shapes, and plates. At 1.35¢, the level recently prevailing in the bar market, this product was $1 a ton below its ten-year pre-war average.

Plates and shapes were $3 a ton below that average, whereas black sheets at 3¢, the price in vogue throughout this year, are selling at $14 a ton above their ten-year pre-war average. While there was ample statistical ground for the advance in bars, shapes, and plates, the independent that led in the upward revision announced the higher quotation only after his books were comfortably filled with orders at the old price. Noteworthy it is also that at about the same time this interest raised its price on structural shapes $3 a ton, another independent booked a large structural contract, erected, on a basis of 1¢ a pound for structural shapes or $10 a ton below the new quotation of the former and $7 a ton below the market that had prevailed previously.

That the independent who led in the advance on bars, shapes and plates had followers, means very little. In the first place, compared with other steel products, those affected sold at too low a price. Moreover, any fairly prominent steel producer who announces an advance will always have a certain number of followers. The latter will try it out for a time. If they can not book orders at the new price, the responsibility for the advance rests with its originator, and they can very easily back water after a certain length of time. As concerns distinctly automotive steel products, especially sheets, producers generally are in a "let well alone" frame of mind.

Pig Iron.—Several sizeable tonnages for second quarter delivery have been contracted for by automotive castings makers in the Middle West, malleable seemingly leading foundry in point of consuming interest. The market's tone is fairly steady.

Steel.—Quite a few transactions in steel bars have been consummated of late for account of automotive consumers at prices below those announced by some of the independents. The automotive industry has the market for cold-finished steel bars virtually to itself. Similar conditions prevail in the hot-rolled and cold-rolled strip steel industry which is now operating at the highest rate of the year, about 50 per cent of capacity. The sheet bar situation is unchanged, $29 being generally quoted, Pittsburgh or Youngstown. Demand for all sorts of sheets continues steady, as do prices. No unusually large commitments are noted but automotive consumers are buying consistently and nearly always for early shipment. Improvement is also noted in the demand for bolts and nuts. Orders for several thousand tons of frame stock and full finished sheets are overhanging the market.

Aluminum.—If there are any bargain lots of sheets around, they are visible to buyers. Ingots, of course, continue in abundant supply, but holders are somewhat more reserved when it come to prices.

Copper.—The market is gradually recovering.

Calendar

SHOWS

April 3-16—New York, Second Annual Electric Automobile Show, Showroom of the New York Edison Co.

FOREIGN SHOWS

March, 1922 — Santiago, Chili, Annual Automobile Show.

March 10-July 31—Tokio, Japan, Peace Exhibition.

April 16-23—Mexico City, Annual Automobile Show, Auspices of the Automotive Division of the American Chamber of Commerce.

April 22-May 1—Prague, Czecho-Slovakia, Fourteenth International Automobile Exhibit.

May — Shanghai. Exhibition of Road Building Material.

May, 1922—Quito, Ecuador, Agricultural Exposition, celebrating Centenary of Ecuador. Automotive Section.

May 1-15 — The Hague. Automobile Show, also Airplanes and Motorboats. Secretary, Spui 185, The Hague.

May 6-21—Scheveningen, Automobile Show.

May 24-June 5—Barcelona, Spain, Automobile Show under Dealers' Direction.

May. 28-June 5—Prague. Motor Show. Hotel de Ville.

July 1-24—London (Olympia). Aircraft Exhibition.

Sept. 1922 — Rio de Janeiro, Brazil, Automobile exhibits in connection with the Brazilian Centenary Associcao Automobilista Brazileria.

Sept. 15-20—The Hague. Automobile Show.

September—Buenos Aires, Argentina, Annual Exhibition, Sociedad Rural Argentina.

Oct. 12-23—London (Olympia). International Commercial Vehicle Exhibition.

November — London (Olympia). Automobile Show.

Nov. 10-Dec. 19 — Brussels. Automobile Show, Palais de la Cinquantenaire.

Nov. 29-Dec. 4—London (Olympia). Cycle and Motorcycle Show. British Cycle Motors, The Tower, Warwick Road, Coventry.

November—Buenos Aires, Argentina, Annual Exhibition, Automovil Club Argentino.

CONVENTIONS

April 20-22—Buffalo, N. Y., Sixth Annual Convention of the American Gear Manufacturers Association.

May 8-10—New York, National Association of Manufacturers.

May 10-12—Philadelphia, Ninth National Foreign Trade Convention of the National Foreign Trade Council.

May 16-18—Washington, D. C., Annual Meeting of the Chamber of Commerce of the United States.

June 11-15—Milwaukee, Annual International Convention of the Associated Advertising Clubs of the World.

June 26-July 1—Atlantic City, Twenty-fifth Annual Meeting of the American Society for Testing Materials, Chalfonte-Haddon Hall Hotel.

August 28 - Sept. 2 — Detroit, National Safety Congress.

Sept. 18-23, 1922—Rome, Italy, Second Annual Meeting of the International Chamber of Commerce.

S. A. E. MEETINGS

Detroit, Mar. 24, April 28, May 26.

June 20-24 — White Suplur Springs, W. Va., 1922 Summer meeting of Society of Automotive Engineers.

Sacramento Market Is Becoming Active

Reflects Opinion of Farmers and Business Men That Good Year Is Here

SACRAMENTO, CAL., March 9—After passing through one of the worst winter seasons ever known here in the automobile industry, indications are there are much better times ahead. Conditions here have been as elsewhere. Financial readjustments and depression, price uncertainties and a general drop in the price of farm products, with no corresponding decrease in freight rates or production costs, have made the farming districts poor fields for the motor car salesman.

Of course, the winter season always is light and spring always shows a decided improvement. But the winter just ended was worse than usual, far worse. There were almost no sales. But the spring is brighter than ever, and sales already are coming along in good shape. With the conviction that prices have been settled for the time being, buyers seem willing to open up the purse strings and the first few bright, warm days of the season saw hundreds of new jobs on the highways of northern California.

The automobile market may be taken as a fair index of conditions generally. Automobiles are bought when there is money available or in sight. Hence the fact that the market is showing activity reflects the belief of the farmers and business men that this is going to be a good year. This winter has been ideal for fruit; there should be big crops which means many automobiles.

S. A. E. APPROVES CHANGES

NEW YORK, March 15—The revisions in the standard body nomenclature, together with other recommendations of the Standards Committee made at the winter meeting of the Society of Automotive Engineers, have been adopted by a mail vote of the society. This excludes, of course, the recommendations pertaining to the stamping of engine numbers which were withdrawn by authority of the council and the revision of the engine testing forms, which was referred back to the Engine division.

Britain May Eliminate Automobile Import Tax

LONDON, Feb. 24 (*by mail*)—The Industries Act passed by the Coalition Government has proved so irksome and expensive to certain British export industries of national importance that it is almost certain to lapse. The dropping of this legislation no doubt is responsible for the rumor that Britain will revert wholly to her free imports policy.

The attempt to keep out automobiles by a 33 per cent duty was frustrated early in its history by the expedient of assembling in Canada and shipping here under the preferential rate, which generally means a drop from 33 per cent to 9 or 10 per cent duty, at which rate the tariff is economically useless and wasteful to collect. Moreover the setting up of assembling works in Britain by American interests and possibly in the near future by at least one French firm will leave the British automobile makers bereft of any bolstering up anticipated from the tariff.

7200 WILLS ORDERED

DETROIT, March 14 — The Wills Sainte Claire Co. has issued a statement that it has contracts with distributors for 7200 cars for 1922 delivery. February production of 15 daily has been increased to 20 daily for March. Six hundred men are now employed at the Marysville plant.

New Orleans Orders Eight Kelly Trucks

Plant Force Grows—International Harvester and Westcott Motors See Brighter Outlook

SPRINGFIELD, OHIO, March 14—Good sized orders are being booked by The Kelly-Springfield Motor Truck Co. During the past week it received an order for eight motor trucks from the city of New Orleans, to be delivered within the next two weeks. There are 75 per cent more men employed in the plant to-day than there were last October. A number of men were added to the force during the past week.

While in the city conferring with Superintendent Charles H. Smart, of the Springfield Works of the International Harvester Co., A. A. Jones, assistant to Cyrus McCormick, works manager, with headquarters at Chicago, said that the outlook is brightening considerably. Smart stated that a shipment of high speed trucks was made during the past week to Australia. The foreign demand for trucks is increasing, he said. The Springfield works is turning out 50 trucks daily. These are being shipped about as fast as they are produced.

Orders have been steadily increasing at the plant of The Westcott Motor Car Co. It was stated by one of the officers of the company that more orders have been received during the past week than for any one week during the past two years. On March 15 the company will increase its production to meet the demands of the trade.

Material has been received preparatory to speeding up production. Indications are that the plant will be busy for the next three months at least. The company is receiving orders from the New England states, north of Virginia, and as far west as Chicago.